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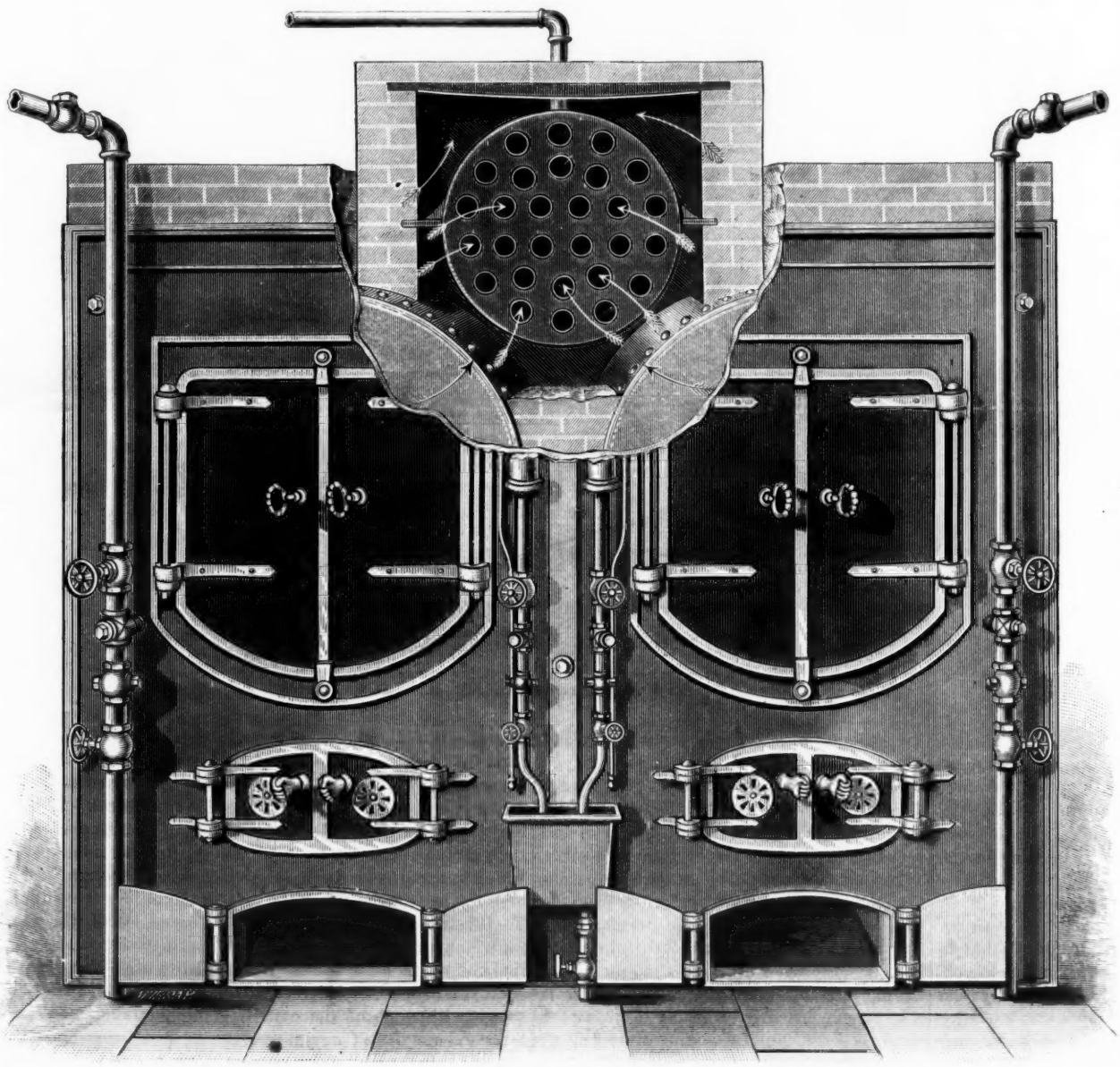
Hussey's Re-Heating, Re-Evaporating and Superheating Device.

As is well known, the escaping gases from a steam boiler or generator, usually of a temperature of about 500°, carry with them a considerable portion of the total heat of the coal burned in the furnace. Any part of this heat that can be abstracted and turned to useful purposes, after it has passed the heating surfaces of the boiler, represents an absolute saving; hence frequent attempts have been made to utilize some portion of it for heating the feed water, and in some instances for other economic purposes, but usually with only a small measure of success.

The engravings on pages 1 and 2 represent, in different forms, a plan for recovering some of this heat, the arrangement being the invention of Levi Hussey, of this city. The general feature of this plan, as represented, is the bringing of the escaping gases into contact with one side of metallic surfaces, the exhaust steam from a non-condensing engine being passed in contact with the other side. In thus passing the steam takes up heat, or becomes superheated, to an extent corresponding with the temperature of the escaping gases and the amount of heating surface provided. Passing through the superheater, the exhaust steam thus surcharged with heat taken up from the waste products of combustion is carried wherever heat is wanted for any purpose, as in heating rooms, drying, boiling, etc., where the heat originally in the exhaust, as well as that which has been added in the superheater, is available.



HUSSEY'S RE-HEATING, RE-EVAPORATING AND SUPERHEATING DEVICE.

As shown on page 1, the superheater is arranged for use with two ordinary boilers, and consists of a cylindrical shell provided with a suitable number of ordinary tubes, the whole being so arranged that the products of combustion on their way to the chimney pass through these tubes and around the outside of the shell, while the exhaust steam from the engine enters the superheater, absorbs heat, and passes on to its destination.

On page 2 the superheater is shown constructed of ordinary pipe and fittings, suitably arranged in an extension of the flue leading to the chimney. Through this pipe the exhaust steam passes, absorbing heat from the surrounding gases. The two engravings represent different ways of construction, which, of course, can be varied to suit different conditions. In whatever way constructed, the passage for the exhaust steam is made of sufficient amplitude, so that no back pressure shall result in the engine cylinder from its use, and with surface enough to superheat the exhaust steam to within about 40° of the temperature of the escaping gases. Thus, supposing the temperature of the gases to be 500°, the exhaust steam will be heated to, say, 460°, its original temperature being, usually, from 212° to 220°.

Beyond this there is, under all ordinary circumstances, a very considerable percentage of water in the exhaust from an engine, which amount is further increased, if, as is generally the case, a feed-water heater is used. In addition to superheating the exhaust, heat is furnished through the heater to vaporize this water, which heat is also available for heating purposes. The heat thus supplied for vaporizing this water—the latent heat—is usually an important factor in the total heat contained in the exhaust steam.

Another consideration, frequently an important one, is that exhaust steam is of too low temperature for purposes for which it may sometimes be desirable to use it. By superheating the temperature is increased without increasing the pressure, which will make it serviceable for heating or drying where a temperature very materially higher than the normal temperature of exhaust steam is required, and which would otherwise require live steam of high pressure. Where a high temperature is not absolutely essential, less radiating surface will be required to produce equal effect than where the steam is of the ordinarily low temperature of exhaust steam. It may also be noted that, since all the heat in the steam cannot be utilized for heating (some of it necessarily escaping just as the products of combustion carry away heat from the furnace), any increase of heat without cost represents a possible gain greater than that increase, because the heat lost need not be more in one instance than in the other. The gain from this will be particularly noticeable where it is desirable to maintain quite high temperatures, or where extremes of temperature are desirable, for rapid drying, etc.

It will be seen that the purposes of this arrangement are, primarily, the abstraction from the ordinarily wasted heat beyond the heating surfaces of a steam boiler of the heat necessary to vaporize the water in the exhaust steam, and making a medium of the whole for conveying an additional quantity of heat from the same source to where it can be usefully employed, instead of permitting it to go to waste through the chimney. A secondary consideration is that by increasing the temperature of the exhaust steam it may be available for purposes where it would otherwise be useless, as in drying rooms, where a high temperature must be maintained, and for other purposes.

Exhaustive tests, made under the supervision of Professor Thurston, of the Stevens Institute of Technology, show that it costs nothing in the way of fuel to accomplish these ends; in fact, observations made by Mr. Hussey had led him to conclude that less fuel was required to evaporate a given amount of water in the boilers with this device in use than without it, which conclusion appears to be borne out by the record of the tests referred to.

Although as here represented, the heater is used for drying and superheating exhaust steam, it is calculated as well for superheating live steam; as, for instance, where steam of low pressure is used for heating rooms, it may be superheated, when the same number of radiators will be much more effective, or a less number will accomplish the purpose. It may also be used to re-evaporate the water primed from a boiler, and to superheat the steam before it passes into the cylinder.

These superheaters are simple, without complication in construction or use. One of them, constructed substantially as represented on page 2, has been in use for several months at the street and number given below, of which tests have been made and every opportunity afforded those interested to note its operation, thermometers being conveniently located for the observation of temperatures in the pipes, flues, and otherwheres. They are not, in use, exposed to the high temperature to which superheaters are usually exposed, and hence are not liable to the accident of being burned out or otherwise destroyed. They are manufactured and erected, under the supervision of the inventor, by the Donaldson Heater Company, 445 West street, New York City.

Shop Notes.

BY FRANK H. RICHARDS.

Chordal is upon a good scent when he talks about elevating tool-posts. An elevating tool-post is, I am certain, worth a hundred dollars a year—33 cents per day—to use upon any lathe, say, up to 20″ swing. The loss in swing over the carriage, if such loss be a necessity, which I doubt, is not of much importance. If work will not swing there, put it in a larger and stronger lathe, where it belongs.

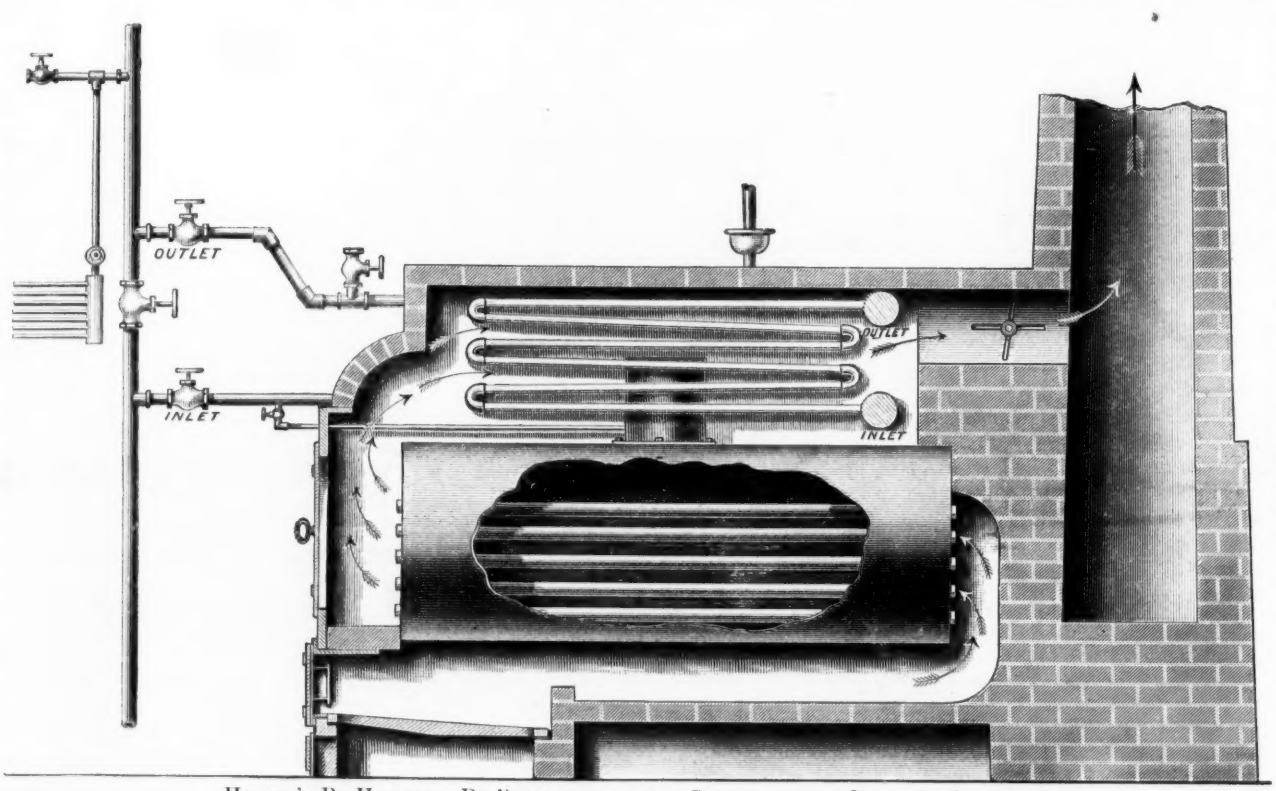
Chordal does not appreciate the Putnam tool-holder. It may be that he has not used it enough to become habituated to it, and so is not a fair judge, though I am ready enough to admit that prejudice *for* a thing, in consequence of habit acquired, is not apt to be any fairer. He says the little blocks which are a part of the holder are a nuisance, and easily lost. The fact is, they are of too frequent use, just like the tool-post wrench, to be readily lost. I know of lathes that have been run ten years, and which retain the original blocks. These blocks are made just the height of the ribs before and behind the tool-post, and a tool may be swung all around the circle and fastened in any direction upon them. A very small but a valuable improvement upon these blocks is, while retaining the equal thickness, to make one of them $\frac{1}{16}''$ thinner and the other $\frac{1}{16}''$ thicker in the other direction. Then, by simply rolling over one or both of the blocks, we get a different pitch to the tool for boring; and also, by changing places with the two blocks, we get, in all, five different pitches to the tool, without cost to anybody. When I wanted to hold a tool firmly for boring purposes, I would use these or similar blocks upon any lathe with a flat-topped rest, removing the collar from the tool-post for the purpose. I think some one could and should devise a tool-holder upon a spherical base, allowing the tool to be pitched in any direction, within reasonable limits, and still be held securely.

Oberlin Smith says a number of interesting things about the planer. When we come to talk about the waste of time in the return stroke, we are not noticing anything new, nor may we infer that, on account of the increased attention given to it, the remedy is near at hand. The trouble is not in the construction of the planer, but in the nature of things. We might as well say that the back stroke of the file in a man's hand is a waste of time, or the raising of the hammer between the blows—though that, I admit, is scarcely a parallel illustration. As to moving the tool instead of the work, much advance is to be made. Walk through an iron ship-yard, and see them shaving off the edges of the plates, and, if you see it for the first time, it makes you open your eyes.

We do not generally realize the weakness of the planer, sidewise, to which Mr. Smith calls attention, because we so seldom use it at its full height. I suppose that nine-tenths of the planing work of the country is done below the middle of the planer uprights, but for high work the side spring is very annoying, and should be, and to some extent is being, cured.

But the thing that troubles me more than this in the planer is not so easily remedied. The way in which the tool is hung out in front of the frame, and, by the strain to which it is subjected, sprung down into the work, when cutting, is, as a general principle in machine tools, incorrect. A tool which, by its own weakness, or by the weakness or the location of its carrier, is continually digging into the work and then recovering itself and springing too far out of the cut, to dig in again the next moment, is in a condition of very unstable equilibrium. This condition, by various means brought about, is the most prolific cause of chattering in all machine tools. If the tool and its holder can spring away from the work (or, which is the same thing, if the work can spring away from the tool), instead of toward it, it adjusts itself immediately and perfectly to the strain; it is in stable equilibrium, and cuts smoothly and truly. Evidently, a planer tool should do its cutting work during what we call the return stroke, rather than during the forward stroke. Where attempts have been made to get the planer to cut in both directions, I suspect that this difference in the spring of the tools has not been the least of the difficulties encountered.

Mr. McConnell instances a shop, now dead and gone, that was all bad, and as presumably one of the bad things in it, he cites that most of the dogs had straight tails. Now that is just the kind of tail that any civilized dog should have, and I have wondered why some of our dog-makers do not advocate and advertise straight-tailed, or tailless, if you choose, lathe dogs. Suppose you have a slim piece of work in the lathe, a nice, long center, and a dog with the traditional and regulation tail in the slot of your face-plate. When the tail is up, the leverage of it in driving tends to spring your work away from the tool. When the tail is down, the work is sprung toward the tool. When the tail is in front, it springs the work up, and when the tail is behind it springs the work down. There is a leverage constantly operating to spring the work, and constantly changing its direction. If you want to work fine, you cannot turn anything round, nor of a uniform surface. There is quite likely to be roughness or chattering upon one or two sides. By all means, use dogs with straight tails. The tail should be triangular in sections, the base of the triangle toward the face-plate, then the driving point upon the tail will be opposite the bearing point of the center, and all tendency to bend the work will be avoided. I would also always use a very short live center. A long center is another abomination of the machinists who "do as they all do," instead of doing as common sense does. I would cut off a long center to have a short one, instead of waiting ten years to have it wear back to its point of highest usefulness and greatest beauty. Tap a number of holes in the face-plate at different distances from the center; then have a stud, with a good collar on it for a base, to fit these holes. The collar may be squared for a wrench, and the stud should always be screwed in firmly. This is the best general method that I know of for driving work upon the centers.



HUSSEY'S RE-HEATING, RE-EVAPORATING AND SUPERHEATING DEVICE.—See page 1.

Tool Dressing, Hardening and Tempering.

BY S. W. GOODYEAR.

With the fact existing that upon the correct shape and quality of tools which come from the tool-dresser's hands depend the quality and quantity of work produced by machinists, more largely than upon almost any other cause, is not this a most important subject? In most shops the man holding the position of tool dresser has not only the forging of all sorts of tools to do, but the principal part of the hardening and tempering to do, on such tools as first pass through the machinists' or tool makers' hands, and then go back to the forge for hardening, in addition to the hardening and tempering of lathe and planer tools and chisels, and tools of like character, which are hardened direct from the forging.

What abuses constitute ground for growling about the average tool dresser's practices, and the quality of tools which he gives us? Where shall we begin? Let us begin with the proprietor, or superintendent, or foreman, or others in authority, who begin by putting their tool dressers, as they would a horse, in harness, where they can only exert themselves in one way, and that in the direction of driving and hurrying.

Of all false economy in shop practice, that which hurries the man who forges or hardens tools for machinists' use is the most ruinous. To illustrate: A lathe tool is to be forged, for which a machinist is waiting. With little fuel and much blast the steel is heated to a good yellow heat, and forged to shape in a hurry, with none of the careful manipulations and gauging of weight of blows or heat at which the forging should cease, which are required to produce good tools, and reheated again in a hurry much hotter at the extreme point where the first work will come than at any other part. It is hardened, and with a rub of emery stick, or otherwise brightening the surface, the temper is drawn to a straw-color, or brown, or purple, according to the belief or practice of the tool dresser or machinist. In from ten to fifteen minutes the tool is ready to grind. In ten to fifteen minutes more it is ground and in the tool post. In ten to fifteen seconds more the point is broken off, from $\frac{1}{16}''$ to $\frac{3}{16}''$, or more. Ten to twenty minutes spent in grinding again. Breaks again. It is ground again, and just when the point is reached, where the tool don't break, it is found to be too soft to stand. There is no need of enlarging upon this subject. Every machinist knows all about it, and most tool dressers know what it is to have twenty jobs waiting, and to be hurried to do some one particular job, just as quick as possible, while many of them know what it is to be snappishly told by some one in authority that they are wasting fuel, if they are found with more than a hatful of coal ignited at once.

Drawing from an actual transaction for an illustration of what may be done, let us direct the tool dresser in forging and hardening a diamond-point tool, for use in planing a steel forging which has resisted all efforts of the machinist to plane it, or the blacksmith to anneal it. Says the foreman: "We have not a tool in the shop that will cut it, and it can't be annealed; twenty-four hours annealing, the last time, did no good." As we look at the glazed, shining, hummocky line, a quarter-inch in width, where tool after tool has been coaxed to cut and would not, after it had been settled in the mind of the machinist with the job in hand that a chip could not be started at the edge of the piece, we can readily believe that the piece is hard.

Now, let us instruct this same tool dresser how to make a tool to plane this piece. First, a good big fire, not too hot. Not too much blast, but just enough. Heat the steel evenly, being careful to have no part at any time too hot. Let the blows, which are required to shape the blade of the tool, be so delivered as to cause no more violent distortion of the metal than is necessary, and continue the hammering until the heat is sufficiently low to insure a thoroughly condensed condition, which cannot be secured if the hammering ceases while the steel is still yellow hot.

Now for hardening. Heat slowly and with great care to have the extreme point of the tool not quite as hot as it is further up. Heat the blade hot enough to harden for its entire length. Let the heat be the lowest that will produce a sufficient degree of hardness. Plunge the blade into cold water clear up to the shank. Don't hold it still in the water while it is cooling. Move it about, to bring it in contact with a fresh body of cold water in place of that which becomes instantly warmed by contact with the heated steel. If the degree of heat is right, you cannot cool the tool too quickly. Now souse it in all over. No need of keeping heat enough in the shank to draw the temper, as, for cutting this extremely hard piece of steel, the temper of the tool must not be drawn.

We give this tool to the same man who said, twenty minutes ago, that no tool in the shop would cut the piece on which he had spent hours and hardly made a mark. With an incredulous smile, he grinds and sets this tool and starts the planer, and, with not the slightest difficulty, this tool is fed down through the glazed surface to a cut at the deepest point of $\frac{1}{4}''$ or more, and, with the feed thrown in, it marches along as steadily as any ordinary tool would do in planing soft steel or cast iron. It is cutting clean—no glazing; no dodging in and out, leaving great ugly hummocks.

Why does this tool act so? Because it is enough harder than the piece it is cutting so that it does not become dull at once, and has sufficient tenacity to stand the strain without breaking. And we have what? Simply a tool which makes it possible to plane this hard piece of steel, when it was impossible before? Aye! that, and more. We have a tool which may be ground and reground till it is worn clear to the shank, and which is not only better on hard work, but will prove better on all ordinary work, just in

proportion as it is possessed of greater hardness and tenacity, and fineness of grain and consequent fineness of edge, than is possessed by the ordinary tool, which must have the temper drawn to prevent breaking.

Employers, give your tool dressers time to do good work. Five minutes' time saved in the dressing of a tool often makes five hours' loss of time in the machine shop. Tool dressers, you who feel overburdened with work, make for yourselves an easy job, by making tools which will last to do ten times as much work. If you use charcoal, don't be too saving of it. A good body of coal and moderate blast should be the rule. If you use bituminous coal, bank up well with fresh coal, but let your heating steel only come in contact with that which is well coked. Don't let all hands and the apprentice boys from the machine shop dip into your fire to harden all sorts of tools. Don't let some old machinist taunt you with the fact that he has a chisel or some other tool that he has kept for years to do special work that can be done with no other tool, without showing him that you can make tools equally as good or better. And you can, if you will take time. Try it.

Railway Exposition Notes.

BY ANGUS SINCLAIR.

THE OLD LOCOMOTIVES.

There has been so much rubbish published about the old locomotives exhibited that sober facts must appear commonplace behind the romances that passed for history during the first days of the Exposition. The managers of the Exposition (which has now closed) were so lavish and loose in their advertised promises of what ancient locomotives and other curiosities were to be there, that men well versed in the early history of railroads expected to find arranged in the order of their construction an exhaustive array of engines whose appearance would be a striking object-lesson on the growth of the locomotive. There would have heen no great obstacle in the way of making such an exhibit, and it would have proved attractive and instructive, but no attempt at system was made. In fact, cheek was far more potent than merit, and assurance and quackery obtained unlimited sway. The small assortment of historical curiosities that was crowded, without order or sequence, in the end of the annex was interesting and attractive as the appliances of a period that has passed away must necessarily be, but absolutely nothing was done to show the articles to advantage. That the antiquarian exhibit was not arranged in an orderly manner was not surprising, considering the ignorance respecting the exhibit expressed by the mouthpiece of the managers at the opening of the Exposition. There the people were gravely told to go and gaze on an engine that is carefully housed in a London museum; they were advised to examine with interest another engine that passed through the regenerative scrap heap fifty years ago; they were promised introduction to men who rest quietly in their graves. The display of ignorance would be amusing were it not humiliating as a sample of our boasted intelligence. It was much in the style of the Fourth of July orator, who alluded to Mrs. Harriet Beecher Stowe as the author of the "Merry Wives of Windsor," and of Charles Dickens as "the man who wrote 'Hyperion,' the book where the siege of Troy is described."

There were five old locomotives in the building, the most recent of which was built within ten years of the opening of the Liverpool and Manchester Railway, which event may be regarded as the genesis of the railway system. First in order came the "Locomotion," which was Stephenson's No. 1 on the Stockton and Darlington Railway. At the time this engine was built there were probably ten or twelve locomotives doing daily work connected with collieries in the North of England, and the design of the machine was an imitation of more successful engines made under the direction of William Hedley, who was really the father of the English locomotive.

This "Locomotion" is a four-wheel engine, all four feet diameter, and it has a plain cylindrical boiler, 10x4 feet, with straight heads. The heating arrangement consists of a single flue, two feet in diameter, which passes straight through, the back part being used as the furnace. The cylinders, two in number, are 10"x24", and are set vertically into the top of the boiler, and a walking beam connects with each piston, and transmits the motion to the wheels by means of rods. The forward cylinder connections attach to the crank pins on right and left of the forward wheels; the back cylinder is similarly connected with the back wheels The two cylinders are then made to work in combination by the side rods.

These side rods were the first valuable improvement that George Stephenson gave to the locomotive, chains and gearing having been previously used as a means of connection. A complication of bars, and rods, and levers on the top of the boiler, which greatly perplex the ordinary visitors who want to know their use, is the Watt parallel motion, which performs the function of guides to the crosshead. The valve rods for both cylinders are on the left-hand side, and are moved by an eccentric, the connections with the rocker being made by a drop hook, which was pushed on the pin by hand.

I shall go more minutely into the construction and working of this and other old locomotives at another time. This engine possessed all the essential principles of the present locomotive, all latest improvements having been developments.

The great fault of this and other early locomotives made by Stephenson was that it would not make steam so fast as the cylinder could use it.

The engine belongs to the Northeastern Railway of England, and has for many years stood on a stone pedestal at Darlington near the scene of its early triumphs.

The next locomotive in respect to age, and the first as regards influence on American locomotive construction, is the "John Bull." This locomotive, built by Stephenson in 1831, was the first engine imported that performed practical service on railroads, and it became the model from which our early locomotive builders worked; although, with characteristic independence, they readily deviated from the original design, making their own engines better adapted for the roads they had to run on.

The John Bull is, what in England, was called the Planet type, with the cylinders in the smoke-box, the slide valve working on vertical seats between the cylinders. The valves are operated by two eccentrics connected with drop hooks, which are controlled by two levers on the deck. Two pairs of wheels (54" diameter) carry the engine, the back pair being the drivers. The forward pair of wheels are not connected in this engine, although it was usual in English practice to connect all the wheels by means of outside cranks and side rods. Water was supplied by two full-stroke pumps, with plungers actuated by the cross-head. There is a dome in the front of the boiler and outside steam pipes leading to the cylinders.

The engine belongs to the Pennsylvania Railroad Company, and was in service 33 years—from 1833 to 1866.

The "Arabian" comes next in turn, and is what is known as a "grasshopper" engine, with upright boiler. The cylinders are also upright, and the pistons connect with levers fulcrumed on the boiler top. The vertical movement imparted to these levers is conveyed by connecting rods to two cranks on a cog axle which drives the wheel axle on the second motion.

Engines of this class did good service for many years on the Baltimore and Ohio Railroad, to which the Arabian belongs. They were slow, but sure, and never failed to get away with all the cars their adhesion was good for.

One peculiarity about the Arabian is that the design is native American, being the work of Ross Winans and Phineas Davis, two pioneers in railroad developments.

The "Pioneer" exhibited by the Chicago and Northwestern Railroad is an interesting Western relic, since she was the first locomotive to traverse the prairies west of Chicago. She has a history worthy of the great road whose traffic she began. Built by Baldwin in 1836, this was one of the first engines that became for a time the standard of that make; high fire box crowned with a dome which supplied dry steam to cylinders placed at a slight angle at each side of the smoke-box. Single drivers driven by cranks inside the wheels and four-wheeled truck carrying the forward end of the engine. The eccentrics are placed outside of the wheels and operate the valves by V hooks and rocker shafts.

What seems to engineers of the present day a curious arrangement is the fact that the pump-barrel is made to perform the work of guides for the cross-heads.

The engine performed acceptable work for about 40 years, the last service being that of running the pay car. For several years she run on the Utica and Schenectady Railroad, and by that company was sold to the Galena and Chicago Union Railroad, where she was engaged first on construction, then on all the varied service of the road until she became too light for ordinary traffic.

The owners now prize the old engine as a valuable memento of the roads of early history.

The "Samson," representative of strength and power, comes last. There are some curious features about this locomotive, and the make of her boiler is interesting as a relic of a struggle regarding a principle of construction which was vigorously waged for years, and is now almost forgotten to history. The first real difficulty experienced towards making the locomotive a success was deficiency of steam supply. William Hedley invented the return flue, and constructed his boilers in that way, which was found to be a great advance. Stephenson stuck to the single large flue, till the multitubular boiler was invented, when he adopted that form while it was yet untried, and brought it out on the "Rocket." Timothy Hackworth, a leading rival of Stephenson's, kept to the return flue, and the friends of each engineer took sides, and a mechanical controversy of great bitterness raged about the merits of the two systems. The multitubular boiler eventually proved best for evaporative results, and Stephenson received enhanced glory in consequence. As late as 1838 Hackworth was constructing locomotives with return flue boilers, and the "Samson" was turned out in that year for a railroad company in Nova Scotia. The engine was heavy for those days, weighing about eighteen tons, and was carried by six wheels coupled. The cylinders, 15½x16, are placed vertically at each side of the rear part of the boiler, and rods connect direct with the cranks outside the wheels. In lieu of guides for the crossheads there is a parallel motion, which lasted so well that the brasses that came out with the engine are still there. The valve motion is worked by four eccentrics and V hooks. Two pumps are worked on short stroke by rods attached to the eccentric straps. The firing is done in the front end, and the engine is reported to have steamed well on slow service.

A TRIP ON THE WOOTTEN LOCOMOTIVE.

No locomotive at the Exposition attracted so much attention and careful inspection as the Wootten engine, No. 372, built by the Philadelphia and Reading Railroad Company. There are now nearly one hundred and fifty of these locomotives in service, and their appearance is familiar enough where the Philadelphia and Reading lines extend; but comparatively few of the visitors to the exhibit had previously seen the engine, and few passed her without a second look. The leading peculiarity about the engine is the great fire-box, overhanging the back drivers, which requires the cab to be placed near the front of the boiler. Where the fire-box is confined within the narrow limit of frames that are inside the driving wheels, the heating surface of the fire-box and the grate area must necessarily be contracted, so that an intensely high temperature is required to generate steam. The invention of Mr. Wootten, extending the fire-box outside the frames, is a revolution in locomotive practice, and opens the way for wide possibilities in thorough combustion and in steam making.

To make locomotives perform the work of fast running, or heavy pulling, there never has been any difficulty in supplying the required cylinder capacity or the weight for adhesion; the trouble has been to generate steam fast enough. As the fire-box is by far the most effective portion of a locomotive's heating surface, designers long ago perceived the advantage of making the fire-box as capacious as possible, but the limit was soon reached. With the ordinary fire-box, 100 square feet of fire-box surface was large; the Wootten engine has nearly double that area, where heating is done by direct radiation.

To describe the engine in detail would occupy too much space, but I will note down a few of the striking features. The cylinders are 18½x22, moving drivers 68" diameter, and to supply steam there is a heating surface of 1415 square feet. Water is supplied to the boiler by two Sellers' improved injectors, No. 8, and the quantity used can be recorded by a gauge on the tank. The driving wheels are placed unusually close for a heavy engine, the distance between centers being only 6½ feet. This admits of a short side-rod, which has decided advantages with a high-speed locomotive. The rods, both ends of side-rods and back end of main rods, have solid ends, and are slipped on the crank-pins from the sides Solid ended side-rods are rapidly becoming the fashion in locomotive building.

Among the locomotives in the Exposition, there were four or five different methods of connecting solid ended side-rods. In the Wootten engine the rod brasses are hexagonal, which prevents them from turning in the strap. A movable wedge keeps the brass in position, and this arrangement admits of lost motion being taken up when the brasses get worn. Steel has been freely used in constructing the engine, the crossheads, links, rockers and other wearing parts being made of that material. The eccentric straps are made of gun metal, and they run better than cast-iron straps usually do. The Goode steam reverse is used, which gives entire satisfaction. A child could do the reversing.

Arrangements had been made to make certain tests of the engine, and on Friday, June 15th, she was taken from the Exposition Building to the Chicago, Burlington and Quincy Railroad shops. The following day, along with others interested in the performance of the engine, I made a trip on her to Aurora, a distance of 39 miles. The train consisted of four coaches, and the run was made to show how the engine steamed while burning anthracite slack, for which that form of fire-box was specially designed.

Before starting, a fine level fire was got up, covering the grates evenly to a depth of about four inches. With the dampers closed, the fire seemed to be dead and inert, with a dark film covering the surface, but when the start was made it brightened up, but never reached, at any part of the trip, that incandescent glare so common with ordinary fire-boxes when the engine is working hard. The firing was done with methodical coolness, every particle of the coal being scattered over the surface, so that when the engine stopped, after running 39 miles in 38 minutes, the surface of the fire was perfectly level, without ridge or hollow. When the fact is considered that the grate to be covered is 8' 6"x8', the skill required to maintian a perfectly level fire will be understood.

When railroad men examined this locomotive in the Exposition the common opinion expressed was that she must be top-heavy, and liable to roll round when running at high speed.

I knew something about high-set British engines and the way they lurch about at high speeds, and I could not conceive how this one could be different. Yet to my surprise this engine developed an entirely different form of movement.

I timed the speed when we were passing the sharpest curve struck, and it was over 51 miles an hour, and the engine went round it with a mixed undulatory and rolling motion which would not have been perceptible had I not been watching for the curve.

On the return trip the engine passed quite a number of successive miles in 55 seconds. At this high speed I was closely watching the behavior of the fire. The exhaust seemed to make the surface of the fire dance, the smaller particles being kept in motion, but no sparks went through the flues.

The immense heating surface enables the engine to steam with a 6" nozzle, and with that opening the blast is not sharp enough to draw sparks over the bridge built in front of the fire-box. This is the true remedy for sparks. Construct the engine so that sparks will not be started, for every attempt to arrest these fire raisers after they have passed through the flues entails complications that intensify the evil.

Making Chilled Rolls and Roll Flasks, Runners and Gates.

BY THOMAS D. WEST.

In the engraving will be found illustrated different ways of constructing flasks, runners, &c., for making chilled rolls. For the most valuable features of this article, I am indebted to John E. Parker, of Beloit, Wis., who, a short time since, sent me a sketch and description of a simple and novel plan, and one that may be valuable for other purposes than roll making.

Mr. Parker was led to devise the rigging shown to overcome the difficulty of the upper neck cracking, caused by the vertical contraction of the body of the roll in cooling. For this purpose he makes what he terms a sleeve, as shown in the engraving. It is made of cast iron, and is about ¼" thick when finished. It is turned on the outside so as to fit easily in the chill. The distance this sleeve sets into the roll varies from 6" to 20", according to the length of roll. The upper neck of this roll is moulded the same as in an ordinary flask. In closing, or getting the mould ready to cast, the height of the neck is regulated by placing three scantling, or screw nuts and blocks, as represented at *D*, *A*, and *K*. The blocks *K* can be either iron or wood, and different sizes and numbers of pieces can be used, as required.

The rolls thus made are used for paper machinery, and vary in sizes from 6" up to 14" in diameter, and from 40" to 80" in length. The chills are made in lengths of 20" to 30", and set one upon the other, as shown at *P*. To handle these chills, the trunnions shown at *R* are used.

Different thicknesses of chills are required for different diameters of rolls. As a rule, about ⅜" of chill for every 1" diameter of roll is about right. In the instance of a roll 14" diameter the chill will be 5¼"; for one 30", 11¼". This heavy body of metal is not for the purpose of resisting the pressure due to the head, but to effect a deep chill from the surface of the casting. A light body of metal in the chill would be sufficient to withstand the pressure, but owing to its becoming quickly heated, it would not sufficiently chill the casting; that is, it would not be chilled as deeply as required.

In making chills, the best of iron should be used, or they will not last long enough to pay for the making. The surface of a chill becomes rough from use, then checks, and eventually is useless. Often, in breaking them up, from the surface to an inch in depth, the iron is found to be burned.

When chills are made in sections, to make different lengths, or for convenience in handling, the joints must be made true and tight. For clamping together, flanges can be cast on, as shown at *Y*.

Mr. Parker, for securing his flask, uses two long bolts and a top ring binder, shown at *N*. This binder being placed on top of the sleeve is bolted to the bottom plate by bolts, *E*, *E*. Should it be desirable to use such sleeves, independently of the lower part of the flask, lugs or handles could be cast on the chills, and the sleeve held down and operated by means of the bolts shown at *F*, *F*. The lower portion, or neck of the rolls, is moulded as shown at the right-hand side of the cut. The flask parts at *V* to allow for making a whirl-gate, as shown in the plan of joint *E*, *E*, of the small flask.

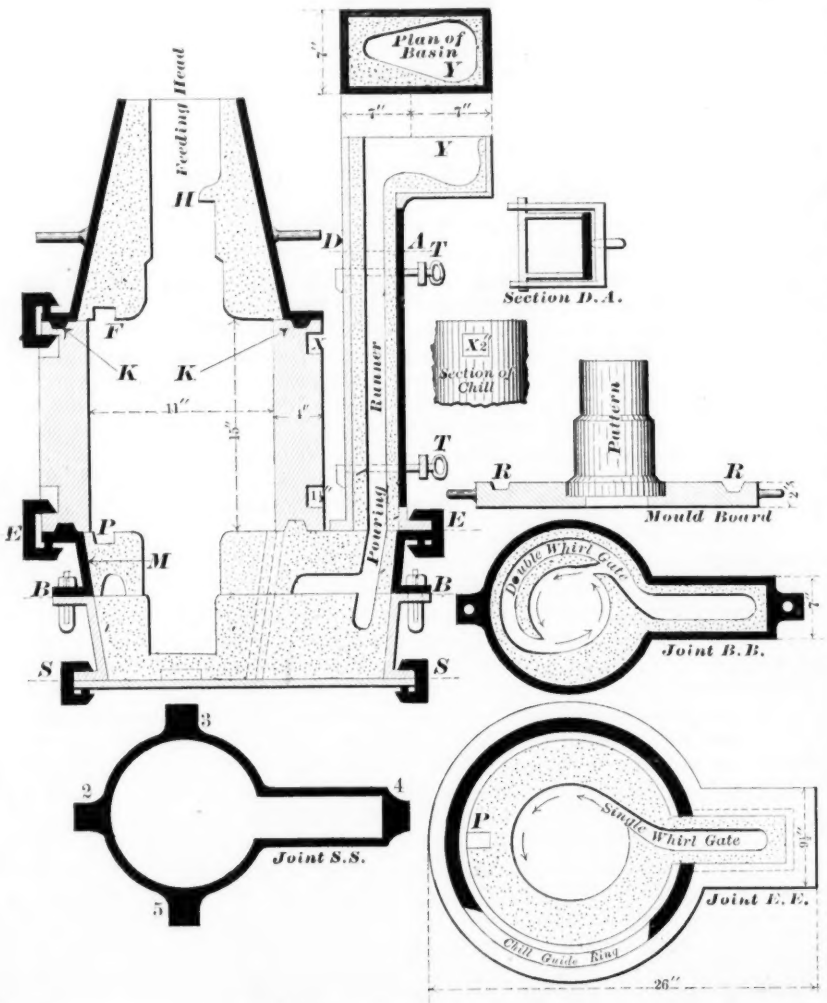
For ramming up the pouring runner *X*, Mr. Parker uses a cast-iron pipe, the arrangement of the nowel being similar to that shown in the details of the small roll flask. Black-lead is rubbed on the chills to prevent the iron from sticking, and the rolls are poured with hot iron.

In order to economize space I have shown attached to the cut of his flask another device sometimes used in pouring such jobs.

W, *W*, are plan and section of a basin, which can be connected to or cast on the end of either a square or round runner pipe.

B represents a quarter-turn pipe or box, jointed to the runner pipe and flask at *S*, *S*. This arrangement saves the work of parting the flask to gate the mould.

At 1, 2, 3 and 4 is shown the manner of constructing the elbow in halves and bolting together. This permits of its being taken apart should there be any trouble in getting out the casting or from the breaking of gates.



A HANDY SMALL CHILL ROLL FLASK.

It would be safer to have the lower joint secured by bolts; the upper joint can be secured with clamps if desired.

The small chill flask represented is a very convenient one, and its construction embodies ideas that are applicable to other jobs.

At *K*, *K*, is shown a sectional view of the guide rings. These are all turned of exactly the same diameter.

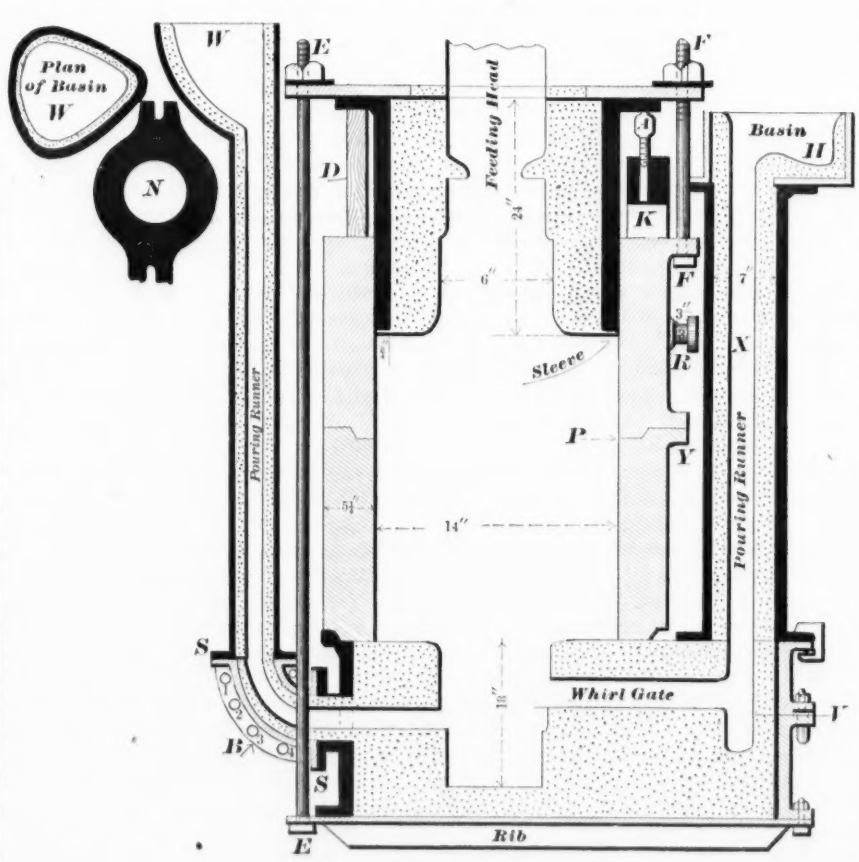
R, *R*, represent grooves turned in a cast-iron mould board. This is used to ram up the cope and nowel on. There is also turned in it a recess to center and hold the neck pattern. By the use of this rigging there is no possibility of the neck getting out of the center in closing.

With the exception of the single whirl gate, joint *E*, *E*, shows the plan or top view of the nowel section *M*. Joint *B*, *B*, shows the bottom view of section *M*.

Numerals 2, 3, 4 and 5 on the plan view of joint, *S*, *S*, represent lugs by which to clamp the bottom plate.

At joint *B*, *B*, the guide pins are made to serve the purpose of bolts or clamps. Holes *X*, *X*, are for clamping and lifting the chills. The runner box has a loose plate made in halves. To hold this plate two straps, *T*, *T*, with threads, are used.

Gating chilled rolls is always a point of prominent consideration.



PARKER'S ROLL IMPROVEMENT.

As a rule the hotter, faster and the more whirl with which the iron fills the mould, the cleaner the chilled face. The temperature of the iron must, however, be regulated by a consideration of preserving the chilled roll from checking or cracking.

The larger the diameter of the roll, as a rule, the duller must be the iron.

I prefer getting the gate as near as practicable to the body of the roll, as by so doing the whirl of the iron is increased. The iron should be poured as rapidly as is possible, without any stopping.

In the cut in which the sleeve is shown one basin is represented higher than the other. Some prefer the lower one, so as to make sure of not filling the feeding head too full, thereby not leaving room for feeding iron. Others prefer the higher basin, *W*, as giving more force to the metal entering the mould.

By careful watching up the moulds, large basins of iron which are not conveniently melted in the absence of an air furnace, are avoided. It is only the chilled portion of the roll that requires rapid pouring; so with long-necked rolls, the pouring can be slower toward the last, giving a better opportunity to watch the rise of the iron.

By using the double whirl gate, shown at *B*, *B*, nearly double the amount of whirl is given the iron. With this double gate I have seen dirt gathered to the center in a ball nearly 3" in diameter. This would rise up through the neck into the feeding head in a solid body, leaving nothing but clean metal in the head. Had the mould been poured without the whirl gate, this dirt would have been scattered and lodged against the surface of the roll or under the upper neck.

This whirl gate is not only useful in making rolls, but for other classes of castings, especially those cylindrical in form.

Jury-masts are well enough known, but jury paddle-wheels, shafts and all, are a novel luxury in ocean navigation, the credit of discovery probably belonging to the Scotch captain of a steamship. The ship breaking her propeller during a recent voyage, and wind failing, holes were cut in her sides to let through a paddle shaft made from a spare spar, to the ends of which extemporized paddle wheels were attached. By bringing the machinery of the winch into use, with the donkey engine and an improvised arrangement of belts and wheels, the ship was propelled at a speed of 1½ knots an hour, which, if not rapid transit, was better than no speed.

John Bright considers weddings always occasions of sadness, but we do not agree with him, says a country editor. They are only occasions of sadness when a man marries a $50 wife on a $15 salary.

Robert P. Porter, one of the members of the late Tariff Commission, who has been traveling in England, furnishes the *New York Tribune* a table showing rates of weekly wages paid to mechanics in the Sheffield district. We append a few of the rates as given by him:

Pattern makers	$7 00
Moulders	7 50
Fitters	7 00
Tyre rollers	9 00
Machinists, best	8 50
" ordinary	7 50
" inferior	6 00
Rivet boys	1 20
Engineers	7 00

A recent discovery at Aleppo, in making excavations beneath the Citadel of the town, of a large breech-loading cannon that must have been buried at least 250 years, is confirmatory of the saying, "There is nothing new under the sun."

The breech-loading mechanism is said to be almost exactly like that used by Krupp, although it will probably be safe to take this part of the statement with some degree of allowance. It is strange enough for all practical purposes that a large breech-loading gun of that age should be found

Craig's Automatic Double-Sight Cylinder Lubricator.

We present with this engravings representing, in perspective and sectional view an automatic lubricator for the cylinders of steam engines, recently brought out by W. H. Craig, and made by the Craig Double-Sight Feed Lubricator Co., Lawrence, Mass., the object, we are informed, being to provide a lubricator for this purpose that shall possess all the characteristics of a reliable sight feed, and, at the same time, one that can be cheaply manufactured. The perspective view shows the general form of the lubricator, and the sectional cut the more important features of its internal construction.

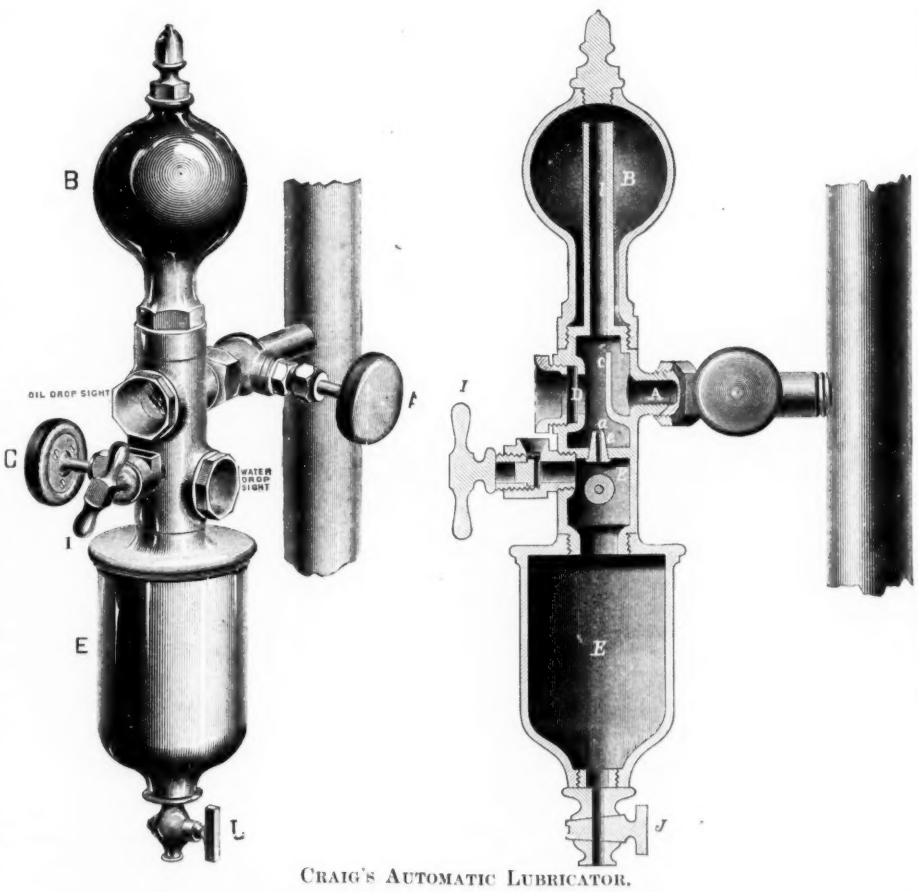
The lubricator is attached to the steam pipe, as shown, and filled with oil through the hopper at *I*. Steam from the steam pipe enters through the inlet pipe *A*, and passes through the tube *b*, to the condensing chamber *B*. Here it is condensed, and finds its way down through a passage (not shown) from the bottom of the condensing chamber to the oil reservoir *E*. This passage is provided with a regulating valve the continuation of the passage leading by a highly polished projection of the valve-seat. Directly in front of this polished surface is a port or opening, which is stopped by means of a circular disc of glass. Through this glass each drop of water, as it passes on to displace a drop of oil, may, being reflected by the polished surface, be distinctly seen.

Below *A* is a chamber *a*, from which a small tube *e*, extends to the oil reservoir. In chamber *a*, is a partition *C*, which extends upwards and by the steam inlet, thus forming a water trap.

In front of this partition is a second port or opening, likewise stopped by a glass disc. The surface of *C*, which is towards the disc, is also polished to form a reflector. The oil being displaced drop by drop by the water admitted to the oil reservoir, passes up through tube *e*, through the water in chamber *a*, and between the polished surface and the glass disc (where it may be seen equally as readily as the descending water), and so over the partition *C*, and through the steam pipe to the cylinder.

The valve *J*, is provided for drawing off the water when the lubricant is all displaced.

By slightly modifying the construction, these lubricators are made to screw at the bottom directly to the steam chest of an engine, similar to the common form of oil cup.



CRAIG'S AUTOMATIC LUBRICATOR.

The Slipping of Locomotive Wheels.

In connection with the prevention of this dangerous tendency in locomotive wheels, M. Poisot recently communicated to the Société de l'Industrie Minérale de Saint-Etienne of France, some valuable results gained in the Mazenay Mines, where no more fuel is now employed for hauling out 100 tons than was employed for 80 formerly. It appears that a month or two ago the joint of one of the cylinder cocks leaked, and a jet of steam escaping from it was directed on to the rail, when the engine took the gradient without once slipping. For two days they worked without repairing it, and the locomotive drew all the trains without the slightest stoppage. In consequence of this experience they altered the cylinder-cocks so as to make them discharge directly on to the rails, and when they got to the gradient the cocks were slightly opened, so that they ascended without difficulty. This new use of steam is a simpler modification of the old idea of washing the rails with a jet of water.

The value of exhaust steam in extinguishing fires recently received a practical test of considerable importance in Berlin. In the drying rooms of a large establishment for making wooden pen-holders steam pipes were led, being capped with an alloy that melts at a low heat. The first intimation of a fire in one of these rooms was the sound of escaping steam, and upon examination it was found that although the fire had made good headway in the stock and the walls of the room it had been instantly extinguished as soon as the temperature became high enough to melt the caps of the steam pipe.

According to figures which we find in the *Railroad Gazette*, stating mileage of new railroad construction so far this year, as compared with corresponding periods of previous years, recent railroad construction is not turning out so slack as has been feared. This year's construction already reaches 1,654 miles, which looks somewhat slim when compared with 3,323 miles last year. The present year's record falls, however, only 100 miles short of 1881, while exceeding that of 1880 by 64 miles. It is two and one-half times that of 1879, four times that of 1878, nearly three times that of 1877, and over 40 per cent. greater than that of 1873.

LETTERS FROM PRACTICAL MEN.

Standards Needed in Machine Tools.

Editor American Machinist:

An article on the editorial page of your issue of June 9th, reviewing current discussion upon the desirability of making certain parts of machine tools to conform to universal standards, appears to arrive at the conclusion that, in the present crude state of the art of construction of machine tools, the adoption of uniform standards by different builders, for the sizes of any of their parts, would stand in the way of future progress in design and construction; and that, besides, it would necessitate a standard in prices as well as sizes.

I will admit that the present endless assortment of sizes of live spindle threads, center tapers, taper sleeves and sockets, bolt slots, tool-carriage slots, and tool-post wrenches, to be found in lathes, planers, milling machines, shapers, drill presses, screw machines, profilers, and the whole list of tools doing about the same size work, does look like a crude state of the art.

But how the bringing of these parts of machine tools to a few standard sizes will necessitate a standard price, or even stand in the way of future progress, is something I fail to understand.

Let us see how the present individual lack of standards operates in every-day practice. In the little shop where I am employed, the tools are: eleven engine lathes, 13″ to 20″, from five manufacturers; four hand lathes, from two makers; four upright drills, from four makers; two planers from same maker; milling machine, tool grinder, screw machine and a suspension drill, all from different makers. Now for interchanging tools. Two engine lathes from same maker will interchange centers and face-plates, but not with upright of same make, and have nearly same size of centers.

Of three lathes from another maker, two will interchange centers and face-plates, the other, bought later, will not interchange either centers or face-plate.

Of six other engine lathes in the shop, no two will interchange with each other, or any other tools in the shop.

Three hand lathes interchange centers, which reduces by one-half the number of drill chucks, drill pads, fork centers, cone centers, &c., necessary to go around, without either waiting, or making another wait, for the only lathe which the one set of tools for doing that job will fit.

There are one 20″ lathe, three 15″ lathes, one dividing head, and one milling machine spindle, all ten pitch, and only $\frac{1}{8}$ range in size. Only two of the six are so near alike as to interchange.

One chuck in the shop has six face-plates, another has three thimbles, still another three, and another four thimbles.

No burr reamer or boring bar that fits an upright drill can be used anywhere else. No bolts that fit either planer can be used on the milling machine. The emery wheel arbors that fit the grinding machine won't fit the hand lathes; and so it goes through the whole list of machine tools.

Now, it does seem to me that if the A. S. of M. E. can come to some agreement as to standard sizes in *spindle threads*, *center tapers*, and *bolt slots*, they will make the greatest one advance that is plainly desirable by all *users* of machine tools.

J. F. KIRBY,
25 Charlestown-street.
Boston, Mass.

Feed Pump vs. Injector.

Editor American Machinist:

In the AMERICAN MACHINIST of May 12th is a communication from A. Aller, in which he sets forth the injector as the best device for feeding steam boilers.

Taking this simple assertion by itself, I would not presume to question it, but for every case where we find simply a boiler and a boiler feeder, there are probably ninety-nine cases where we have boiler, engine, exhaust heater for feed water and a boiler feeder; and while the injector is undoubtedly the best feeder in one case, in the ninety-nine other cases it is far from being a desirable or economical device, and the claims made in its favor are misleading to those who accept and believe everything they see in print, whether proven or not.

Too little attention has been given to economy in boiler feeding. I know of many a case where parties have purchased high-priced automatic engines, and then entirely overlooked the matter of economy in that apparently small matter of feeding the boiler; in some cases using no heater at all.

They were willing to pay the builder who would guarantee five per cent. better duty five hundred dollars higher price for his engine, but the engineer who might advise a good big heater, or a fifty-dollar feed pump, that would have saved ten per cent., or perhaps more, would have been considered too extravagant by far.

Considering the mechanical action of the injector alone, in forcing water into a boiler, nothing could be more economical; for where a feed pump loses quite a fraction of the power required to drive it—in friction, slip, leakage, &c.—the injector returns to the boiler practically all the heat abstracted therefrom. But the loss comes from the fact that in using the injector as a heater, we lessen the value of the exhaust heater.

In ordinary practice injectors add about 100° of heat to the feed water, all of which comes direct from the boiler, and is no saving. Perhaps 50° more can be then added in the exhaust heater, which is a real saving, as this would otherwise have been thrown away. Now, if the entire 150° had been taken from the heater, the saving would have been about three times as great. For example, suppose a common case of a high pressure engine, working with 80 pounds boiler pressure, and feed-water at 60°. Every pound of water evaporated under this pressure, from 60°, requires 1152 units of heat. We will put temperature of the exhaust steam at 212°. Now, with an injector alone, none of the surplus heat of the exhaust (212° − 60° = 152°) can be saved. With injector adding 100° and the heater the balance, to say 210°, we have 60° + 100° from 210° = 50°, which would be all that could be saved out of a possible 150°. On the other hand, with a pump driven by the engine, the water could be supplied to heater at 60°, and the entire 150 units of heat, up to 210°, saved from the exhaust waste. Thus, the proportion of heat saved from the exhaust, to the total required for evaporation under 80 pounds pressure would be:

With injector alone..... $\frac{1}{1152}$ = .000
" " and heater..... $\frac{50}{1152}$ = .042+
" power pump and heater $\frac{150}{1152}$ = .130+

The charge is made against the pump that power is required to drive it; but, if properly constructed and arranged, the amount is very insignificant when compared to the power of the engine it will supply.

An injector makes a first-class auxiliary feeder, and I hardly consider a steam plant complete without one, but for constant use, instead of a power pump, where exhaust heat can be utilized, the injector is wasteful of fuel and boiler capacity.

In case of a condensing engine its use might be advised, if the temperature of condenser could be maintained, but if the injector will not take water at 130° to 140° it would be best to use a pump.

The above figures show the importance of using the heater to its best advantage, feeding constantly and no more than is wanted, and not by heads as many do, thereby letting the heater stand idle part of the time.

F. B. RICE.

Dr. Siemens says: "The amount of light given out by a gas flame depends on the temperature to which the particles of solid carbon in the flame are raised, and Dr. Tyndall has shown that of the radiant energy set up in such a flame only the twenty-fifth part is luminous. The hot products of combustion carry off at least four times as much energy as is radiated, so that not more than one hundredth part of the heat evolved in combustion is converted into light. This proportion could be improved, however, by increasing the temperature of combustion."

Master Car Builders' Convention Notes.

(Continued from last issue.)

Secretary Forney reported that every year the difficulties of settling satisfactorily the subjects dealt with by the association become greater and require the exercise of increasing skill, knowledge, experience, and experiment. As an instance, the secretary cited an old and a new question, viz.: "What is the best height for drawbars?" and "What is the best form of self-coupling drawheads?" The former question could easily be settled from the experience of the members; the latter question required investigation in a difficult field. The secretary directed attention to the fact that at past meetings, during the history of the work, resolutions relating to details of car construction had been passed which conflicted with each other. As it was not desirable that the influence of the association should be cited as pulling in contrary directions, he recommended that a committee be appointed to deal with the matter.

IRON CARS STILL EXPERIMENTAL.

Report on iron cars, read by Mr. Davenport, indicated that nothing of consequence had been done or learned about the construction of iron cars. Experiments had been made as to the strength and durability of iron as material for cars, but parties working in this direction had not perfected their plans sufficiently to found recommendations upon.

The committee intimated that a steel brake beam had been invented, which was giving satisfaction. A member was called on, who gave some particulars regarding this beam, in which he made the point that it is less liable to break and get under the wheels than wooden beams. This subject drew out no discussion.

STANDARD WHEEL GAUGE AND SHAPES FOR FLANGES.

The committee on a standard wheel gauge and form of section for the treads and flanges of wheels was required to report what action, if any, is required with reference to the adoption of a standard wheel gauge, and to recommend a standard form of section for the treads and flanges of wheels, and whether experience indicates that any advantage results from the use of a conical form for the treads of wheels, and if so, how the advantage is shown.

This committee recommended the coning of wheels, and submitted sketches of a proposed form of tread and flange. We reproduce these sketches on this page, half scale. They also recommended that the distance between the inside of the flanges be made 4 ft. $5\frac{1}{4}$". One member of the committee made a minority report favoring wheels with straight tread.

When this report came up for discussion it gave rise to a long debate, which developed a great diversity of opinion among the members as to what ought to be the correct distance between the inside of the flanges. In this debate a curious feeling of deference to the requirements of the Pennsylvania Railroad practice was demonstrated. Various members gave their experience with coned and straight tread wheels. Their experiences were somewhat conflicting, one set of men getting the best results from the form which had been decidedly defective with the other parties. The majority of speakers preferred coned wheels, principally because that form provided for a longer period of wear before the tread began to work hollow. Others were disposed to think that coning prevented the cutting of flanges, a view which was combatted by the other side, whose leading objection was that the cone form caused hard riding.

Regarding the distance between the inside of the wheel flanges, many members considered that 4 ft. $5\frac{1}{4}$" would leave too much lateral play when the cars passed over the Pennsylvania and other tracks of 4 ft. 9" gauge. Suggestion that all railroad companies should bring their gauges to the proper standard was not received as a practicable solution of the difficulty, and, after two hours' discussion, a motion was carried recommending that the distance between flanges be 4 ft. $5\frac{3}{8}$".

MOST ECONOMICAL CARRYING CAPACITY FOR FREIGHT CARS.

The committee on the most economical carrying capacity for freight cars reported that they had sent to the various master car builders a series of questions, intended to elicit information respecting the effect which the increased loads that cars have been required to carry of late years has had upon the expenses for repairs, and the effect of heavy loads on rolling stock generally, but upon axles in particular. Their opinion was asked about what increase in size of wheels, axles and journals they would consider necessary for a load of 10,000 pounds per wheel, and they were required to state whether or not it was desirable to change the dimensions of the M. C. B. standard axle. Upon the replies received the report was based. The opinion prevailed that the heavier loads had been followed by a corresponding increase in the cost of repairs, but no data were furnished to show the ratio. Axles had broken occasionally under their loads, but such axles were generally small or defective. The committee concluded that it was not necessary to change the dimensions of the M. C. B. axle, as they deemed it perfectly safe when the load on the car did not exceed twenty tons. They asked that the committee be continued for another year.

When this subject was brought up for consideration in the meeting a short and desultory discussion ensued. Instances were given where 25 tons were carried by cars on axles $3\frac{1}{4}$x7" and no particular trouble had been experienced. But connecting lines refused to accept cars carrying this load on account of their bridges not being considered safe for such loads.

The feeling of the members present was against increasing the load of cars until special provision is made by changes on the permanent way.

THE HEATING OF CARS.

The report on heating of cars was principally noteworthy from the fact that the committee had turned their backs upon a venerable feature of railroad travel. They recommended the abolition of the stove, so the wood-box and other ancient accessories must go also.

Various forms of heaters were commended as preferable to the stove for numerous reasons, wherein cleanliness and no liability to roast the passengers in case of a wreck were most potent.

ECONOMY OF GRINDING CAST IRON CAR-WHEELS.

The report presented on the "Economy of grinding cast iron car wheels" was a long document which gave particulars of the experience which most of the members had had with ground wheels, and opinions on the effect of grinding were freely expressed. One particular point forcibly brought out by the report was that cast iron wheels are rarely a true circle when cast, the distortion of figure varying from $\frac{1}{16}$" to $\frac{5}{8}$". The effect of this is to cause the wheel to impart an eccentric motion to the axle, which, at high speeds, causes rough riding of the cars. The machine for grinding wheels brings them to a true circle. It is used on new wheels and on wheels that have flat spots which do not go through the chill.

It was unanimously agreed by the committee that the grinding of wheels results in much smoother running of passenger coaches; that the wheels wear longer and are not so hard on the track.

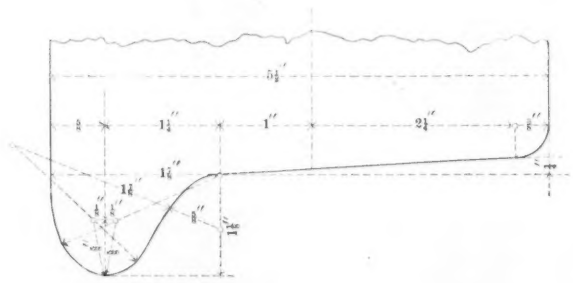
When the subject was called for discussion a few remarks were made by several members, but nothing new was elicited. One member advocated the use of a six-dog chuck in securing the wheels for centering, as he had found that method gave more accurate results.

WROUGHT IRON STEEL TIRED WHEELS.

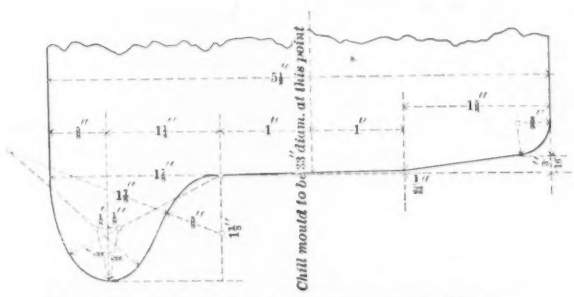
"The use of wrought iron wheels with steel tires" was introduced.

Mr. McWood gave some particulars of experience he had with wrought iron wheels with steel tires, and they had given entire satisfaction.

A visitor from England was called upon for his experience, and he entered at considerable length into the details of British practice with wheels. Wrought iron wheels with steel tires are universally used for cars, and they have been found to possess qualities absent from all other kinds of wheels tried. The wheels are made from 36" to 42" in diameter, with spokes, a construction which gives a certain degree of elasticity tending to absorb shocks, and which makes cars run easier besides being lighter in wear upon the permanent way.



STANDARD FLANGE FOR STEEL TIRED WHEEL.



STANDARD FLANGE FOR CHILLED IRON WHEEL.

REFRIGERATOR CARS.

The Committee on Refrigerator Cars made a long report, entering with minute details upon the various methods for keeping cars cool, so that perishable goods may be transported long distances without injury. There are three kinds of refrigerator cars. The first is built on the supposition that all needed is a low temperature; the second provides for coolness and some circulation of air; the third kind is constructed to provide not only cold temperature, but constant circulation of dry pure air.

While fully describing the details of all the cooling methods, so that parties interested in the subject may judge of their various merits, the committee countenanced only those kinds which provide for free and constant circulation of air.

It was their opinion that no other kind of refrigerator car should be endorsed by the master car builders.

The discussion on this subject developed no new information.

STANDARD GAUGES FOR ROUND IRON.

The Secretary made a statement about standard gauges for the inspection of round iron, so that the iron might be rolled to the proper dimensions for manufacturing screws. The M. C. B. had been in communication with the Pratt & Whitney Company, who had prepared an excellent set of gauges, and he recommended that the meeting accept these as their basis of standards.

The preliminaries were settled for accepting the standard.

THE BEST FORM OF CAR TRUCK.

The committee appointed to report on the best form of car truck encountered difficulties which prevented them from reaching any conclusion. Until some decision is reached as to limits of load and speed of trains, they considered it impracticable to arrive at any decision about the proper dimensions of trucks.

Their report took the form of recommending points for discussion, which the committee expected would bring out information founded on the experience of the members. The points presented were: "The most economical loads and speed. Shall the standard truck have a swing or rigid bolster? The standard truck should have the brake beams situated between the wheels, and suspended from a part of the truck which remains a fixed distance above the rail. The truck should admit of the use of automatic brakes. There should be few parts, simple in shape, and so constructed as to be easily removed for repairs. The material should be of iron or steel."

In connection with the report of this committee, a letter was submitted from George Westinghouse, Jr., of Pittsburg, giving particulars of a car truck which he considered well adapted for the carrying of a brake to which continuous power could be conveniently applied. Blue prints were furnished illustrating this truck with the brake rig attached.

W. T. Hildrup, in opening the debate on the subject of car trucks, pictured the variety of forms in use and graphically described the varied experiments which had gradually developed the truck till it had reached its present condition. He considered the Diamond truck the best in use at this date, but it does not follow, because this is a great advance over the crude devices of early days, that it is the best truck which can be devised. The advances we have made justify us in expecting that other valuable improvements will come. He gave some particulars of how his road puts truck material together. They practice just as much exactness of construction as if they were building a lathe, every hole being drilled and reamed to an exact gauge. When any point developed weakness, they had followed the practice of strengthening it, and this system of building had produced the very best results. Mr. Hildrup objected to the swing bolster, and gave detailed particulars of its action on curves, tending to prove that it causes injury to wheels. About axles, there had been a remarkable change of sentiment in the last twenty-five years. At that time the smallest possible journal consistent with strength for carrying the load was considered the best for eliminating friction. To-day we are reaching out for even larger sizes than those given as our standard axle. He had found a suspension truck which reached his ideal as the proper method for carrying the weight of cars. Several members expressed opinions favorable to the suspension truck, and it was strongly recommended as the M. C. B. standard. Others, in succession, defended the swing bolster, and its action was defined.

A lengthened debate ensued, in which the excellencies and defects of various trucks were well ventilated. A motion was finally passed requiring the executive committee to inquire into the merits of the suspension truck, and report. Parties interested in the suspension truck under discussion took the lead in entertaining the Master Car Builders during this meeting.

CAUSES OF ACCIDENTS TO TRAIN AND YARD MEN.

The adjourned discussion on the "Causes of accidents to train and yard men" was opened by Mr. Torrey, who has proved himself deeply interested in the subject. He produced specimens of defective ladder rounds and step fastenings, which were a

leading source of danger to train men, and were a disgrace to roads requiring them to be used. He strongly urged the attention of members to increased efforts and care to prevent avoidable danger. If the committee on this subject would bring drawings of drawheads and other parts that proved specially dangerous to train men, it would enable the association to make definite recommendations. In this connection, it was to be regretted that railroads in the various States are not compelled, under severe penalties, to report every case of accident to an employe. If this were done, it would demonstrate where specially dangerous appliances were used.

The discussion on this subject indicated that great carelessness and apathy had been displayed by car builders and railroad companies respecting the safety of train men. A member drew attention to new cars now being sent out by the Peninsular Car Company, which were supplied with ladders that were disgracefully defective and dangerous.

A long discussion ensued about dimensions of dead woods. A resolution was passed appointing a committee to draw up a circular directing the attention of railroad managers to recommendations of the association respecting means for securing greater safety to train men.

NEXT PLACE OF MEETING.

The committee on next place of meeting recommended Saratoga, which was adopted.

Subjects Treated at the Mechanical Engineers' Meeting.

In addition to the papers named in issue of June 9th, as offered to be read at the Cleveland meeting of the Mechanical Engineers, and those printed entire or by abstract in our last week's issue, the following named papers were presented:

"Reuleaux Kinematic Models." By J. Burkitt Webb.

"Multiplex Telegraphy." By Thos. Whiteside Rae.

"Comparison of Evaporative Tests of Different Qualities of Coal, and a Review of a Report of Quartermaster-General on Fuel for the Army." By Wm. Kent.

We publish below a paper presented by Prof. Sweet.

A New Method of Constructing a Crank Shaft.

BY PROF. JOHN E. SWEET, SYRACUSE, N. Y.

In making a pair of steel crank shafts larger than could be managed by the tools in the shop, if handled in the ordinary way, recourse was had to unusual means, and with so satisfactory results that it is hoped that a brief description will prove interesting and, to some extent, useful.

The crank disks, some 10″ thick and 44″ in diameter, had to have 10″ holes for the shafts and 7″ crank holes bored 15′ between centers. To do this on a lathe in the usual way required a lathe of 6 ft. 2″ swing, and the unsatisfactory operation of moving and resetting each piece of a ton and a half's weight.

For use in ordinary work in the shop is a boring bar mounted on the carriage of the lathe, the axis of which is 9″ below the center of the lathe spindle. This boring bar is rotated by independent belt power, and the feed of the lathe is arranged to run independent of the lathe spindle, so that a piece fastened to the face plate of the lathe may have the holes bored in it when brought into the correct position.

The trick was so to locate the disk on the face plate that both holes could be bored by simply rotating the face plate from one to the other.

Fig. 1 shows the position when the shaft holes were bored, with the dotted lines showing position when boring the crank holes. The crank pin holes were bored 7″, and the pins, which were of tool steel, turned $7\frac{1}{1000}$″ their entire length. Then the part that was to form the wearing surface was ground and polished to 7″, and the pins forced into the disks from the back, the finished

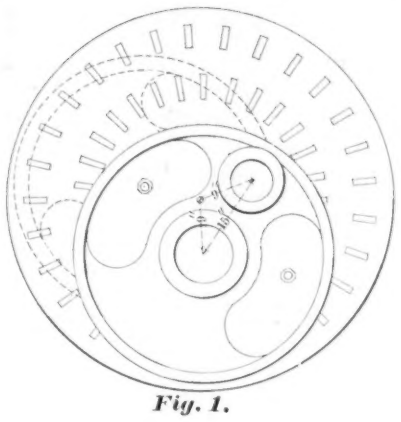


Fig. 1.

portion serving as a guide to insure a fair start.

Next, so much of the rough shaft as was to fit the crank disks was turned and keyseated and the shafts forced in. For this an allowance was made of $\frac{1}{100}$″, and is believed to be sufficient, since it required, as near as could be determined, about 90 tons' pressure to force them in.

To insure the shafts being truly parallel with the crank a cast-iron chuck, as shown at

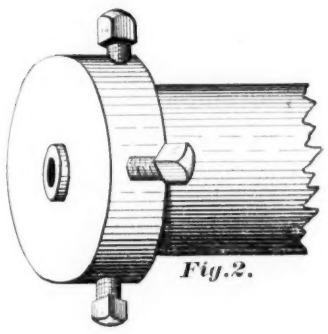


Fig. 2.

Fig. 2, was prepared to go over the out-board end of the shaft provided with four heavy set screws, and a $1\frac{1}{2}$″ reamed hole in the center. In this hole was put a female center, the rig forming an adjustable center by which the out-board end of the shaft could be moved in either irection.

With the shaft in the lathe, and one of Mr. Porter's V pieces and a sensitive level, it was possible to get the parallelism perfect. Removing the female center from the chuck and putting in bushings to fit the center drill and counter-sink, new centers were made in the shafts and the work finished eminently satisfactorily.

So perfect had our method of boring the holes in the cranks proved that the final error did not exceed $\frac{1}{50}$″ in the length of the 10-feef shafts.

Master Mechanics' Convention Notes.

CHICAGO, June 19, 1883.

The convention was called to order this morning by the President, Reuben Wells, of the Louisville and Nashville Railroad, in the Appellate Court Room of the Grand Pacific Hotel.

Mayor Harrison, in a neat little speech, welcomed the Master Mechanics to Chicago. He assured them that they would be treated well in this city, and charged well for the entertainment they received.

There was a large attendance, and thirty-nine new members signed the constitution. To-day the room is crowded, and a strong disposition is manifested to go right into the work of the convention, and there is enough business before them to keep the active members busy.

The range of subjects chosen for discussion at this meeting, includes some of the most important themes known to the railroad and mechanical world.

"Improvement in Boiler Construction" is first on the list, with Jacob Johann, of the W. and St. L. Railroad, for chairman of committee.

"New Plans of Construction and Improvement in Locomotives Engines" comes next, with W. Woodcock, of the C. R. of N. J., chairman.

"The best and most Practicable System of Paying Premiums to Engineers and Firemen" is the third subject, the chairman of the investigating committee being F. M. Wilder, of the N. Y., L. E. and W. Railroad. This subject was proposed two years ago, and was considered important. The committee found it so difficult to arrive at any conclusion upon that they did not report last year, but asked for more time.

"Smoke-Stacks and Spark Arresters, to include best form of Cone for Diamond Stack," is the fourth subject investigated, with James Sedgly, L. S. and M. S. Railroad, for chairman.

"Is the Extension of the Smoke-Box Beneficial, and to what Extent?" comes next, with J. S. Patterson, of the C. I., St. L. and C. Railroad, for chairman.

"In what part of the Boiler should the Check and Valve be placed, either for Pump or Injector, to produce the best results?" has been in the hands of T. B. Twombly, C. R. I. and P. Railroad, for investigation.

"Is it best to Cone or Taper Driving Wheel Tires, and if so, to what extent?" has received the attention of J. D. Hollister, of the S. F. and W. Railroad.

"Standard Reamer for all Bolts used in Locomotive Works, the proper taper or angle to make them, and a system of Gauges to correct and maintain a standard when worn," is the eighth subject for investigation aud discussion, and has been worked on by Coleman Sellers, of Philadelphia.

Next subjects in order are papers to be read by the associate members, Lewis F. Lyne and F. W. Dean, of Harvard University.

The final technical subject is, "Is the use of Metallic Packing for Piston Rods and Valve Stems desirable?" and is in charge of R. H. Briggs, of the M. and O. Railroad.

When a recess was over, giving new members the opportunity for signing the constitution, the president delivered a long address.

In opening, Mr. Wells thanked the association for the honor they conferred on him last year by electing him president during his absence. He reviewed the history of the association, dilating on its aims and objects. A great many new and valuable mechanical ideas had been given to railroads by their combined labors. Their methods of discussing subjects had many excellent features, for they gave good suggestions on points where members were uncertain, and they exposed many fallacies which were often cherished privately, and needed the light of debate to convince the holders of their mistaken views.

Investigations of the association have resulted in many improvements on the locomotive and in the methods of doing work. The valve-motion had been greatly improved, although the maintaining of a good valve-motion has many difficulties to contend with.

The hard service to which locomotives are subjected makes the keeping up of the valve-motion far more difficult than in the case of stationary engines. He referred to the Joy valve motion, but did not know that there had been much improvement of steam distribution effected by that system; thought the subject needed more investigation.

Alluding to the continued calls for increased economy in railroad operating, he thought the proper way to reach this end was by constructing locomotives of greater durability, and in perfecting the machinery generally. Believed it was cheaper to make one engine perform a 60,000 mileage in one year by keeping it going than in employing two engines to do the same work.

There had been great increase in the size of cylinders of late years, without a corresponding increase in thickness of the castings. The flanges are often made too thin, so that they break off at times, when this damage might be avoided by increased strength.

He did not consider that rail-heads or wheel sections are satisfactory as surfaces of contact.

True economy requires heavy engines to haul the trains.

He does not think it pays to have a four-horse team pull a one-horse load, but it is worse to have four single horses employed on each load separately.

The President pictured the trouble some roads have with hard water, the expense and difficulty attending the use of calcareous waters in boilers and their efforts to deal with the subject.

About the economy in consumption of coal he thought the engineers and firemen were the parties who could do most to effect a saving. Thought that something should be done to impress upon these men the urgent necessity for care and watchfulness in preventing waste of coal.

A good continuous brake for freight trains is an appliance much needed, but there are immense difficulties in the way of inventing a brake that will be effective and free from complication.

The President closed his address by giving obituary notices of the death of three members—Samuel J. Hayes, John E. Martin and Howard Fry.

The Secretary, J. H. Setchel, then read his annual report which indicated that the association is in a very flourishing condition.

When the regular order of business came round the first subject for research was called, but was passed owing to the absence of the chairman of the committee.

Next subject was then taken up, and the Secretary read a paper prepared by F. W. Dean, associate member, on "New Plans of Construction and Improvement of Locomotive Engines," his investigations and deductions being given in place of the labors of the committee appointed to inquire into the subject.

The paper from Mr. Dean is very long, and discusses many questions of locomotive construction and management. The paper reads like a strong arraignment of American locomotive management and offers English practice as the models our master mechanics should defer to.

The paper is evidently the production of a novice who has some knowledge of theoretical mechanics, and therefore deems himself competent to dictate to practical men of experience on subjects he has had no means of properly acquainting himself with.

Mr. Sprague of the Porter-Bell Locomotive Works, then raised the question whether hot or cold water is best for testing boilers. He contended it was best to use hot water, because that brought the boiler as near as possible to its conditions of service.

A short discussion ensued, but nothing new was developed.

The Dean paper was then taken up and discussed.

Among the new Associate Members elected by the Master Mechanics' Association was Angus Sinclair of the AMERICAN MACHINIST. Further notes of the convention will appear in our next issue.

H. L. Perrine, hydraulic and mechanical engineer, who for the past two and one-half years has had charge of the Davidson Steam Pump Company's interests in Colorado, has returned to New York, and has been permanently engaged by that company with headquarters at their works in Brooklyn.

Various kinds of buildings are erected upon the grounds of modern industrial expositions, but, according to the following paragraph from the *Southern Manufacturer and Builder*, of Louisville, the visitors to the great Southern Exposition, which opens in that city August 1, are likely to see a new kind of structure: "A lake is to be built in Central Park, and the park will be used as a promenade ground for the visitors."

The total miles of railway in the State of New York, September 30, 1882, were 7,269, and the number of locomotives in the State was 3,541. This is an average of almost two engines to every mile of road—a far higher average than prevails in the country generally. The total number of locomotives reported at the end of the year 1881 was 20,116 for 104,325 miles of road, or less than one to every five miles.—*Railway Age.*

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NEW YORK, JULY 7, 1883.

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Master Car-Builders' Convention.

The Master Car-Builders' Association is the oldest society of railroad men that joined together for the purpose of instructing the members and improving appliances by mutual intercourse, investigation and object-lesson work. Their combined labors must have achieved much in the way of widening out the knowledge of the individual members. Their work has been invaluable in improving the railroad rolling stock. Incalculable trouble and expense has been saved by their single action of bringing drawheads to a certain height above the rail. Many lives have been preserved by this reform, and their adoption of other devices conducive to safety and uniformity have prevented the mutilation of many passengers and trainmen. The Association has been at times somewhat conservative about recommending the adoption of new appliances, but their constant policy has been towards increasing the means of safety in the operating of trains, without giving the sanction of their name to inventions of doubtful utility.

The mechanical world generally is under a deep debt of gratitude to the Master Car-Builders for their action, as far back as 1872, in adopting a standard of screw threads. They adopted the threads in use by Sellers, which were recommended by the Franklin Institute, and as a means of carrying their desires into effect, they printed the details of the system, and sent the circulars to car-builders and manufacturers, urging them to use the uniform system of screw threads, bolt heads and nuts. This method of proselytizing had an excellent effect, in letting mechanical men know what was going on in the line of uniform sizes, and a marked improvement soon became apparent. The knowledge that railroad companies would not accept work which did not conform to the Franklin Institute standard had a wonderful effect in banishing odd-sized taps and dies. Tool-makers quickly perceived the advantage of uniform sizes, and they heartily co-operated with the Master Car-Builders in effecting the needed reforms. But the iron-makers were more backward. They were not particular as to sizes of iron bars, so long as they approximated the required diameter. An inch bar was anything within $\frac{1}{16}$ of its supposed size, an evil which led certain tool-makers to make taps and dies a fraction above or below the standard diameter. This might have worked immense mischief, had it been permitted to grow unchecked. The Master Car-Builders took up the subject again last year, and urged the members to strictly adhere to the standard sizes, without fractions. They also commended the Pratt & Whitney Company's gauges, as an accurate and rapid means of testing the sizes of iron bars, the consequence being that these accurate gauges are getting into daily service, and iron that does not pass their test gets rejected. Every man who has anything to do with the repairing of machines is interested in the struggle to make screw-thread sizes mean something definite, and in the efforts to have iron bars measure the thickness they are reputed to be. The efforts of the Master Car-Builders have done more to bring about the desired reform than the labor in this direction of all other technical bodies combined.

Unusual interest has been awakened in the Master Car Builders' Association by the wider base given to the organization in the new constitution adopted last year. The changes then made extend the scope of its membership, and the best friends of the association expect that its usefulness will be promoted thereby. The leading officers of railroads are brought into more intimate connection with the society, which will tend to strengthen its acts, making them more binding, and its recommendations regarding rolling stock are more likely to be carried out.

These circumstances and the attraction presented by the Exposition drew out a very large attendance in the meeting which convened at the Grand Pacific Hotel, Chicago, June 12th.

It was the largest meeting of the association ever held. Quite a large number of subjects were presented for consideration by reports of committees. On another page will be found a synopsis of the proceedings in regard to most of the subjects that came before the convention.

The Cleveland Meeting of Mechanical Engineers.

The recent meeting of the American Society of Mechanical Engineers at Cleveland, although, in point of numbers, not as well attended as some of the preceding meetings of the society, was, in point of interest and in generally satisfactory results, second to none yet held. The sessions were, from the first to the last, well attended by the members present in the city, and the reading of papers and details of business received more than ordinary attention. The increased interest of the members was due not only to the painstaking efforts of the officers of the society, but particularly to the efforts of the Cleveland members, generously aided by the members of other and kindred local societies and the citizens of Cleveland generally. Not only was money freely subscribed to assist in entertaining the members from a distance, but what was of greater importance, the local committee appreciated and did their whole duty, and more, too. This was especially noticeable on excursion day, when, from the large number of places visited and the distance covered, it might with reason have been expected that some confusion would have resulted. So far from this being the case, the affair throughout was conducted with almost automatic precision, the members of the committee, apparently, being everywhere at exactly the right minute to keep everything moving on time and in order. Not only, however, was the excellent work of the local committee noticeable at the excursion, but as well at the meetings of the society, at their headquarters, and, in fact, wherever they could be of service to members who were strangers in the city, and whom they took upon themselves to welcome.

At the reception the citizens' committee managed with equal tact and thoughtfulness, while, not to be outdone in matters of courtesy, the ladies of Cleveland were equally solicitous for the welfare of the lady visitors.

A particularly pleasant and important feature of the meeting was the facilities afforded the members to become acquainted with each other, through the arrangements at the society's headquarters in the Forest City House. This is a matter which has, in the past, received too little attention. Taken altogether, the Cleveland meeting was a success, and there is much pertinency in the advice of President Leavitt that the society make this an example for future meetings.

As usual, there was too little time for the reading and discussion of papers, several being read by title only. This is a matter that can hardly be remedied. If anything suggests itself as to the disposition of papers at the meetings, it is that where papers—particularly short ones—are fully prepared, and, with cuts, in type, ready for distribution, perhaps their reading should take precedence of long papers confessedly incomplete, and which, having to be rewritten before final presentation, can hardly be considered as before the society.

EXCURSION DAY.

Thursday was devoted to sight-seeing, the Pennsylvania Railroad Company and the New York, Pennsylvania and Ohio Railroad placing trains running on schedule time at the disposal of the local committee. At all points visited the excursionists were met by those ready to show them objects of interest, so far as time permitted. At the Otis Iron and Steel Company's Works the processes of steel-making from casting to rolling into finished plates, as well as the forge department, and including the process of mechanical puddling, were briefly inspected. The large Porter-Allen engine, running at a piston speed of 800 feet per minute, was an object of considerable interest to the visitors.

At the works of the Cleveland Forge and Iron Company the process of forging was inspected. This is one of the largest concerns of the kind in the country, and is equipped for doing a variety of both light and heavy forging.

The works of the Cummer Engine Company were found busy on a line of their automatic engines. The works of this company are new, but the work of construction is being systematized by the superintendent, W. M. Barr, in a way that will undoubtedly show good results. Various parts of engines in different stages of completeness showed the care that is used in their construction, and bid fair for future popularity.

At the Union Screw Company's Works the automatic machinery for making screws of all sizes excited a good deal of interest, and was suggestive of how far automatic processes may eventually reach out into other machine industries.

At the Brush Electric Works the machinery was started up (the visit there was at the noon hour) and the process of testing the dynamos shown.

A serious attempt at the annihilation of friction was seen at the shops of Warner & Swasey. This was the running-gear of the dome of the McCormick observatory for the University of Virginia. The dome, with the running-gear, is being built by this company, and the latter was found set up in their yard. It is 45 feet in diameter, the weight of the dome (10 tons) being carred on nineteen sets of triple conical wheels. These wheels are radially arranged on short shafts. The weight of the dome rests on a circular plate, which in turn rests on the center wheels of the system, while the two outer wheels of each set rest and roll on a flat circular truck. It will thus be seen that there is no journal friction from the weight or load, this friction being all rolling friction of the wheels, 15" in diameter, on a smoothly planed track. The guides by which the circular motion is preserved are likewise journaled wheels, thus reducing the friction to a minimum. As erected, the weight of the dome is represented by pig iron, and the whole, weighing 10 tons, is revolved by the application of a force of 30 pounds. This with their fine line of small improved machine tools fully engaged the attention of the visitors during their stay at the works.

The officials at the large shops of the Cleveland Malleable Iron Works afforded the visitors every opportunity for witnessing the making of malleable iron, answering a variety of questions touching their processes with the most apparent willingness.

At the works of the Cleveland Rolling Mill Company more of the processes of iron and steel manufacture were witnessed, an object of considerable interest being the reversible train, operated by friction clutches moved by a steam cylinder large enough for a 100-horse power engine.

At these works was also seen in operation one of the large pumps designed by the chief engineer of the works, E. H. Martin, and illustrated in the AMERICAN MACHINIST of August 26, 1882. This pump, designed for water works of any kind, was working very smoothly and satisfactorily.

The Central Furnace, at present producing 200 tons of pig iron daily, was visited; also the water-works, in which are a pair of Cornish pumping engines of a capacity of 8,000,000 gallons, two pairs of Worthington engines, and a pair built at the Cuyahoga Works, Cleveland, each of 10,000,000 gallons capacity.

The interest in the sight-seeing was much increased by furnishing each member with a programme in the shape of a nicely-printed book of twelve pages, containing information of general interest.

In addition to the sight-seeing "by programme," many members visited, at different times during the session of the society, and at its conclusion, other works of interest. At the shops of Cox & Prentiss the manufacture of twist drills was seen, and by special invitation to members of the society many of them visited the experimental works of the Deering Seamless Barrel Company, where barrels are made of pulp complete in one piece. The machinery for this purpose

is, as indicated, only experimental, but with the improvements that already suggest themselves there is no apparent reason why barrels may not be made cheaply by this process. We have in a previous issue briefly referred to this subject.

At the Cuyahoga Works was noticed some heavy mining machinery, building for the Peninsula Mining Company. The Cuyahoga company built the large blowing engines at the Central Furnace, as well as much of the large machinery for other establishments in Cleveland. Our regular contributor on foundry matters, Thomas D. West, is in charge of the foundry department of these works, and has done himself great credit by the excellent quality of heavy castings made for the Peninsula and other jobs, with facilities that seem quite inadequate for handling such work. It should be noted, however, that the company are erecting an extensive addition to the foundry, which will be supplied with modern cranes and other facilities for handling the heavy class of work which they are doing. Mr. West is a thorough believer in order and system, and carefully-preserved memoranda enable him to take full advantage of past experience.

Literary Notes.

A copy of "How to Get On in the World," as illustrated in the life and language of William Cobbett, by Robert Waters, is laid upon our table, from the well-known printing establishment of James W. Pratt, 75 Fulton street, New York, who is publisher of the book. To the book proper is added "Cobbett's English Grammar, with Notes," study of which, equally with a perusal of the main body of the work, will be likely to give young men, whether apprentices or what not, a vivid idea of what can be done, under the most depressing circumstances, by one who has youth, health, brains and determination on his side. The book proper, with the index, contains 285 pages, while the appended matter adds nearly an equal number. The price of the complete work is $1.75 per copy.

We are indebted to the U. S. State Department at Washington for a bound volume of 1,175 pages, containing the Consular Reports upon the commercial relations of the United States with foreign countries for the years 1880 and 1881. This publication comprises, complete in one volume, the various pamphlet reports which have appeared from time to time during the two years mentioned, extracts from which have at various times appeared in our columns. The book is issued by the Government printing office, and contains many valuable suggestions and much useful information relating to foreign trade.

The J. N. Mills Publishing Company, 145 Broadway, New York, have just issued a "Steam Users' Business Directory," for the New England States—price, $5 00—in same style as the similar directories applying to other States, heretofore published by them. It is arranged by city and town, alphabetically, and is intended to contain the "names, business, location, and number of boilers used in each establishment." The book also contains about thirty pages of reading matter interesting to engineers, some of it being taken from the columns of the AMERICAN MACHINIST. The same reading matter is also printed in separate pamphlet form by the same publishers, under the title of "The Steam Users' Journal of Useful Information," etc.—price, 25 cents.

We have received from the publishers of the *Dry Goods Bulletin and Textile Manufacturer*, 88 West Broadway, New York, a "Hand Book of the Hosiery Industry of the United States," containing about 140 pages, and including a directory of hosiery manufacturers. It gives a history of the hosiery industry, with a great deal of technical and statistical information relating to the trade. A directory of jobbing houses in the principal cities is also included.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(230) T. S., Pittsburgh, Pa., asks: Can you tell me of a work that contains complete instruction for setting, lining up, and running roll trains for making iron? *A.*—We know of no work on this subject complete enough to answer your requirements.

(231) W. R., Providence, R. I., writes: I wish to find description of a process for welding plates of iron as they are placed on the side of a vessel, thereby doing away with joints, as in ordinary construction. If you can inform me in what publication this can be found I shall be obliged. *A.*—We do not think what you mention has ever been accomplished.

(232) G. W., Philadelphia, Pa, asks: How can I render cloth water-proof and at the same time have it pliable? *A.*—There are several processes for doing this, one of which, said to be employed for garments of the French soldiers, is: Dissolve 2¼ lbs. of alum in 10 gallons of boiling water; dissolve the same quantity of sugar of lead in the same quantity of water, and mix the two solutions. The cloth is soaked in this mixture, then wrung out and dried, after which it is washed.

(233) C. R., Washington, D. C., asks: 1. What metal will expand and contract the most by the application and withdrawal of heat, and at the same time deteriorate the least from use? *A.*—Zinc of common metals, will expand and contract the most, but if repeatedly heated to a high temperature would probably deteriorate quicker than brass. If not heated too high, it would preserve its qualities for a long time. 2. How much will a rod of such metal, 9″ long, be increased in length when subjected to 220° of heat? *A.*—If of zinc, by increasing the temperature by 220° it will be lengthened about 3-100ths of an inch; if of brass, it will be lengthened about two-thirds as much.

(234) H., Woodberry, Md., writes: 1. We use a 500-horse power engine and a "Bulkley" inspirator and injector [injector condenser?] with which we get about 28″ vacuum. Could I attach a pipe to the exhaust pipe, close to the cylinder; the pipe to convey steam to an injector for feeding the boiler? *A.*—We suppose you refer to an injector operated by exhaust steam. You could not operate it in this way. Any attempt to do so may result in a serious accident, by taking water into the cylinder. 2. When we are running two injectors the steam pressure falls rapidly. Is the injector an economical boiler feeder? *A.*—The injector is popular as a boiler feeder. Exactly what its economy is as compared with other means of feeding boilers has not been definitely determined, so far as we know. Perhaps the trouble is that you feed your boilers too fast, in which case, whatever the means of feeding, the steam pressure will be reduced. You should feed so as to just supply the boilers, keeping the feed on as near as may be all the time.

(235) H. F. H., Brooklyn, N. Y., writes: I have three horizontal tubular boilers, each 5½ feet diameter and 16 feet long. The boilers are in a room by themselves. Each boiler has a 1½″ feed connection, provided with a stop and check valve at the boiler, also a stop valve at the heater, and a check valve on the delivery valve, in front of the Korting injector and feed pump. We have trouble in feeding through the heater with the pump, but none with the injector. The feed water is supplied through the heater by the pump at a temperature of 180°; when feeding with the injector through the heater the temperature is 240°. The pump has broken down two or three times, the last time breaking the piston in pieces. I want to ask: 1. What is the benefit of a dome on a boiler? *A.*—The object for which a dome is put on a boiler is to supply dry steam. It is claimed by many that drier steam can be supplied through a perforated pipe than by means of a dome. The dome weakens the boiler to some extent. 2. The feed-pipe, 1¼″ diameter, passes up the front and along the top of the boiler into the engine-room, down again to the floor and through a coil heater and back again to the boilers, being about 350 feet long, with ten bends, and two check valves, and two stop valves on each boiler. I claim that this pipe, under the above-named circumstances, should be 2″ instead of 1¼″ diameter. Am I right or wrong? *A.*—Under the circumstances named we should use a 2″ pipe.

BUSINESS SPECIALS.

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

Portable Forges, $10. Holt M'f'g Co., Cleveland, O.

James W. See, Consulting Engineer, Hamilton, O.

Steam Economy—124 pp., in boards. By mail, $1. A. Wilkinson, Manayunk, Pa.

Chas. T. Porter, Mechanical Engineer, Tribune Building, (Room 42,) New York City.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

For sale, 25″ lathes of best designs from new patterns. George A. Ohl & Co., E. Newark, N. J.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Latest and best books on Steam Engineering. Send stamp for Catalogue. F. Keppy, Bridgeport, Ct.

Universal grinders for lathe-centers, chucks, angles or cylinders. C.C.Hill, 144 La Salle st., Chicago, Ill.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York

Foot Power Machinery, for workshop use, sent on trial if desired. W.F. & John Barnes, Rockford, Ill.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

H. E. Penney, manufacturer of Steel Spring Cushioned Helve Hammers. Photo and circular on application. Minneapolis, Minn.

New tool chest, price $10. See description in AM. MACHINIST, April 14th, or send for circular. Goodnow & Wightman, 176 Wash'ton st, Boston, Mass.

Castings furnished for 18″ and 21″ swing engine lathes. Gearing turned and cut if desired. C. F. Batt, Phœnixville, Pa.

The latest improved Match Machinery is made by the White Machine Company, Brown street, Waterbury, Conn.

Speed and drill lathes, 10″x4′, new design. Self-clamping rest, first-class material and work. Parties about to buy will do well to inquire. C. Wing, Greenfield, Mass.

"Patent Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton street, New York.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant. $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Free—"Useful Hints on Steam." A book of 96 pages, illustrated. Valuable to engineers, steam users and those about purchasing steam machinery By mail, 15 cents, or free on personal application. E. E. Roberts, 107 Liberty St., New York City.

The National Feed-Water Heater - the best and cheapest in the market; warranted to heat water by exhaust steam up to 206° to 212° Fahrenheit. This heater commends itself to every practical man. For description and prices, apply to the National Pipe-Bending Company, New Haven, Ct.

Twenty Years with the Indicator. By Thos. Pray, Jr., Editor Cotton, Wool and Iron, royal 8vo, 162 pages, 87 illustrations, printed on heavy toned paper. Bound in muslin, beveled edges. Price, $1 50. Sent postpaid to any address, on receipt of price, by the Boston Journal of Commerce Publishing Company, Boston, Mass.

The New Pulsometer, price, 600 gallons per hour, $50; 1200 do., $75; 3,600 do., $100; 6,000 do., $150; 10,000 do., $175; 18,000 do., $225; 25,000 do., $275; 45,000 do., $400; 60,000 do., $500; 120,000 do., $1,000. Write for descriptive book, mailed free. Pulsometer Steam Pump Company, 83 John street, New York City.

Wanted—Correspondence with engine builders, boiler makers, and supply dealers in steam goods We manufacture the *cheapest* Injectors and best Steam Jet Pumps in this country, and offer to *live men* the most liberal terms ever named. Drop postal for particulars to J. B. Sheriff, Son & Co., 68 Water St., Pittsburg, Pa.

"Useful Information for Steam Users"—a 100-page illustrated pamphlet, carefully compiled from the best authorities, on the care and management of the steam engine and boiler, with hints for engineers and firemen. Engineers everywhere should have this work. Send 25 cents in P. O. stamps for a copy The J. N. Mills Publishing Co., 145 Broadway, New York.

For a strictly first-class automatic engine, from 10 to 60 horse-power apply to the Straight Line Engine Company, Syracuse, N. Y.; medium or high-speed; perfect balance; fewest parts and fewest working joints; uniform speed at all ranges of power or steam pressure; the best material and workmanship in all vital parts; the most correct distribution of iron; unexcelled in smooth running.

Chordal's Letters.—John Wiley & Sons, 15 Astor Place, New York, have now ready a new and enlarged edition, with six additional plates, of Chordal's Letters, comprising the choicest selections from the series of articles entitled "Extracts from Chordal's Letters," which have appeared in the columns of the AMERICAN MACHINIST; with a steel portrait of the author, and upwards of fifty original illustrations by Chas. J. Taylor. One volume 12 mo. of nearly 400 pages, cloth, $2.00. Will be mailed and prepaid on the receipt of the price.

MANUFACTURES.

It is said that the Gould system proposes to establish, this fall, at Palestine, Tex., car-building shops for all its lines.

The Keystone Iron Works, of Reading, Pa., J. V. Craig & Son, proprietors, resumed work June 18th, after six months' idleness.

The Union Iron Works, San Francisco, intend to erect extensive works during the summer, and will connect them with the railroad.

The Cummer Engine Company, of Cleveland, O., will send one of its 150-horse power automatic engines to the Louisville Exposition.

A stock company has been organized at Chattanooga, Tenn, with $50,000 capital, to build a chair factory, near the Roane Iron Works.

A company of Utica, N. Y., capitalists propose to organize for the manufacture of needles, using machines invented by Eugene Fontaine, the locomotive man.

Frey, Scheckler & Hoover, Bucyrus, O., are about to enlarge their shops, so as to build six brick and tile machines per week. They now turn out three per week.

Some of the citizens of Jackson, Tenn., have gone to work in earnest to raise the means of building a cotton factory in that city, with every prospect of success.

Durkee & Keffer, of Chicago, are turning out some shaping machines of novel design, and every department of their works is being run on full time.—*Industrial World.*

Mr. Hill, of the new million-dollar Mile End thread mill, Newark, N. J., is now in England, purchasing the machinery for the mill. It is not expected that it will be ready to run until the middle of next winter.

In the furnaces, foundries, and machine shops of the Brass Iron Works, Fort Wayne, Ind., there are employed fifteen hundred men. Business is reported as very lively, and the establishment is crowded to its fullest capacity.

The long-unused property of the New York Steam Engine Company, at Worcester, Mass., with buildings, engine, &c., has been purchased by William Allen & Sons, of the Worcester Boiler Works, and is to be fitted up for their occupancy.

According to the Titusville, Pa., *Herald*, the oil region is full of second-hand machinery, for sale cheap, since the oil boom has subsided. The shops in that section are very dull, wages have declined, and some financial troubles have been experienced.

A. Harris, Son & Co., Brantford, Ont., employ nearly three hundred men, and run overtime to enable them to keep up with the demand for their celebrated harvesting machinery. They have recently filled some large orders for European countries.

The Missouri Boiler and Sheet Iron Works, of St. Louis, Mo., O'Brien & Smith, proprietors, are now being enlarged to double their present size and capacity, by the taking in of an adjoining building. They are now putting in considerable new machinery.

The property of the Gibbs & Sterrett Manufacturing Company, at Titusville and Corry, Pa., was sold recently for $21,000 above the mortgage of about $300,000. The purchasers will probably reorganize the establishment and start the factories running.

The Rollstone Machine Company, Fitchburg Mass., sold a lot of cane-seat chair machinery last fall to a party in South America. He is so well pleased with its working, that a second order is to be placed with the same company for other woodworking machines.

The Eagle Machine Works, of St. Louis, Mo. Voita & Dworak, proprietors, have been incorporated under the laws of the State of Missouri, under the corporate name of the Eagle Machine Works Manufacturing Company. The capital stock is set down at $20,000.

The Philadelphia and Reading Railroad Company are enlarging and making extensive improvements at their Reading, Pa., machine shops. The foundations have been begun for a blacksmith shop three hundred feet long. A large number of the recently suspended hands have been reinstated.

The Pacific Can Company, San Francisco, Cal., has just been incorporated, mainly for the manufacture of tin cans for packing purposes, under the system invented by Edwin Norton, of Chicago. Their new factory, 275 feet square, will be ready for business July 1st. John Lee is president, and the company's capital is $250,000.

There is talk of organizing a new safe manufactory at Akron, O. The *Beacon* of that city says: "Several enterprising local capitalists manifest an interest in the matter, and Mr. James White, the inventor, will come from Canton next week with models of his new safe, prepared to demonstrate its many points of advantage over every other safe now manufactured."

At Woonsocket, R. I., George H. Miller has purchased one acre of land, on which he will build a large machine shop for the manufacture of rotary cloth presses, printing presses, and other machines. The main building will be 103x50 feet and two stories high, with an ell 34 feet square, for an engine and boiler-room. The building will be ready for occupancy in November.

P. B. Whitney, at present with Peck, Stow & Wilcox, Cleveland, has bought the machine shop and foundry at Chagrin Falls, Ohio. The *Exponent* says: "The firm will employ a number of hands, and manufacture tools for machinists' use, Mr. W. being the patentee of several which are now being made East on a royalty, but which will be produced solely in the Chagrin Falls Works as soon as completed and running."

We have received from the Harrison Boiler Works of Philadelphia forty-four letters (in photo-lithograpic form), addressed to them by prominent industrial and business establishments, detailing the favorable results derived by the concerns by whom they were signed, from a more or less extended use of the Harrison boiler. Several firms have a large number of the boilers in use, and some have used them for a long term of years.

Machinists' Supplies and Iron.

NEW YORK, June 21, 1883.

The general supply trade is in about the usual condition at this time of year, with no important changes to note. Prices of pig iron continue to rule in favor of buyers, though it is said the blowing-out of a large number of furnaces has given a firmer tone to the market. We quote American pig No. 1 $21 to $22; No. 2, x foundry, $18.50 to $19. Scotch pig dull at nominal rates. Lake copper 15¾c., with small sales. Lead, 4c. to 4½c., common. Tin, prices a trifle lower; we quote Banca 22c.; Straits and Malacca, 21¼c. to 21¾c., Spelter, common domestic, 4 6-10c. to 4 7-10c.; refined, 8c. to 8¾c.; Silesian, 5¼c. to 5½c. Antimony easier, asking prices same as last week: Hallett's, 9⅝c., Cookson's, 10⅜c.

WANTED

"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue.

Wanted—A good, steady draughtsman. Address Engine Builder, care AMERICAN MACHINIST.

Wanted—A first-class pattern maker. Address J. H. & D. S. McEwen, Wellsboro, Pa.

Wanted—A good moulder. Address Eureka Foundry, Eureka, Nevada.

Wanted, Tool Maker—A good workman can find permanent employment. Joel Hayden Brass Company, Lorain, O.

A mechanical draughtsman, 25 years old, with best references, is open for an engagement. Address J. U., AMERICAN MACHINIST.

Wanted—A first-class mechanical engineer and draughtsman; one who has experience in the construction of automatic engines. Address, with references, P. O. box 175, Richmond, Va.

Wanted—A young man of good habits wants a place to learn the machinist trade, in a shop manufacturing first-class machinery. Good references. C. P. St. John, Prattsburgh, Steuben County, N. Y.

Practical machinist wants a situation (out West) to take charge of a machine shop and make drawings. Reliable, accurate, and ready at special appliances. References. Address F. D., AM. MACH.

Wanted—A first-class tool-maker and machinist; one accustomed to making tools for engineers brass work. State experience, wages, and where last employed. Address Box, P. O. box 2610, Toronto, Canada.

Wanted—Position as foreman, or general foreman, by a man who has had two years' experience in a machine shop as such. Is a thoroughly practical man. Address Box 5, care AMERICAN MACHINIST.

Wanted—Position by a young man as general superintendent, or assistant to the manager of an architectural iron works. Good designer and draughtsman. Technical education. Experienced in all departments, from estimating to erection. Can refer to former employers, and to some of the finest roof and other architectural work in the country. Address T., AMERICAN MACHINIST.

For Sale—Twenty-one newly-bound volumes of *Engineering*. Address, Books, AM. MACHINIST office.

Light and fine interchangeable machinery to order. Foot and power lathes; slide rests, &c. Catalogue for stamp. Edwd O. Chase, Newark, N. J.

Wanted—Catalogues and price-lists of good mechanic and boiler-makers' tools. Critchley & Whalley, Portsmouth, N. H.

Wanted—A set of pulley patterns, correct sizes; also a set of skein arms, in good condition. Address, Wm. Osborne, Malster, Barton street, Hamilton, Canada.

Wanted—Special machinery and tools for manufacturing hangers, shaftings, pulleys and couplings. Send estimates and catalogues, W. H., care AM. MACHINIST office.

Wanted—Eligible site for iron foundry and machine shops, containing three to five acres; situated on railroad or water-front, within thirty miles of New York City. Address Manufacturer, AMERICAN MACHINIST.

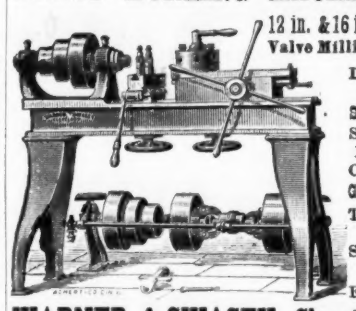
For Sale—One-half interest in a good machine shop, located in a splendid town of 10,000 inhabitants. Machinist or foundryman, with $3,000 ready cash, will find it to his interest to investigate. Address, box 2,045, Ottawa, Ill.

A practical mechanic, with years of experience, wishes to correspond with any one wishing to go into horse-shoe nail business. Estimates given. George H. Smith, No. 55 Lyon street, New Haven, Conn.

Wanted to rent or purchase, a machine shop and foundry, fitted for work of medium weight, having a capacity to work at least two hundred men, and situated not more than two hours ride from New York. Address Foundry AMERICAN MACHINIST.

For Sale, an Unusual Opportunity—Machine and blacksmith shop, with large foundry, tools, and patterns; having large run of custom work, as well as contract work in foundry. Located two blocks from depot. Railroad side track on shop grounds. For information, call on or address William Fidler, 171 Eighth avenue, Topeka, Kansas.

BRASS WORKING MACHINERY.



12 in. & 16 in. Monitors
Valve Milling Mach's
Double Key Lathes,
Speed Lathes
Slide Rests
Revolving Chucks for Globe Valves,
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Small Tools and Fixtures.

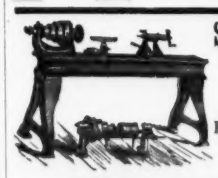
WARNER & SWASEY, Cleveland, O.

COOKE & CO., DEALERS IN
Machinery and Supplies,
22 CORTLANDT ST., NEW YORK.
AGENTS FOR

The Waters
Perfect Governor.
Having Adjustable Speed, Automatic Safety Stop, Sawyer's Lever, and Solid Composition Valves and Seats. Also
SUPPLIES
For Machinists, Railways, Mills, Mines, &c.
Please send for circular and state that you saw the advertisement in this paper.

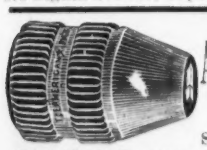
Bradley's Heating Forges,
FOR HARD COAL OR COKE,
BRADLEY & CO., - Syracuse, N. Y.

BOSTON BLOWER CO.,
BOSTON, MASS.
Blowers and Exhausters
OF EVERY DESCRIPTION.



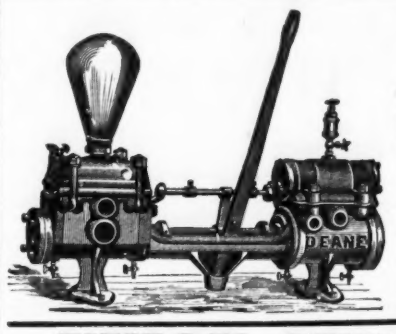
Superior 10, 12 & 16 in.
SPEED LATHES.
Built by FAY & SCOTT, DEXTER, MAINE.
Send for Description.

JOSIAH MACY'S SONS,
189 & 191 Front Street, New York,
MANUFACTURERS OF
LUBRICATING OILS,
Lard, Sperm, Whale and the
"UNICORN,"
Brands of all gravities, suitable for all grades of work; light, heavy, slow and high speed.
Samples Submitted Free. ESTABLISHED 1822.



THE
American Drill Chuck
Is the cheapest 3-parallel Jaw Chuck. Price, $4.
Sold by all Tool Dealers.
BREHMER BROS., 440 North 12th Street, Philadelphia, Pa.

REMOVAL.
Knowles' Steam Pump Works
HAVE REMOVED TO THEIR NEW QUARTERS,
93 Liberty St., New York.



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Steam Pumps for Every Service.
Send for New Illustrated Catalogue.
THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.
92 & 94 Liberty St., NEW YORK. 54 Oliver St., BOSTON. 226 & 228 Lake St., CHICAGO.

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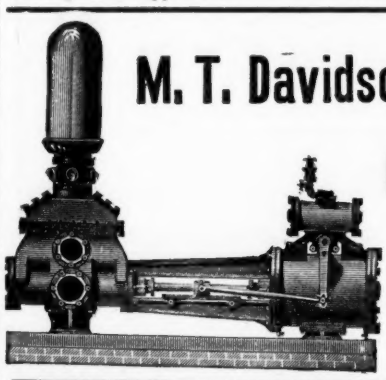
UNION EMERY WHEEL.
EMERY, EMERY WHEEL MACHINERY AND TOOLS A SPECIALTY.
Automatic Knife Grinding Machines, Wood Polishing Wheels, Grinders' and Polishers' Supplies.
Catalogues on application. 38 AND 40 HAWLEY STREET, BOSTON, MASS.



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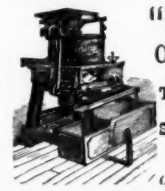
M. T. Davidson Improved Steam Pump,
MANUFACTURED BY
DAVIDSON STEAM PUMP CO.,
OFFICE AND WORKS,
41 to 47 KEAP ST., BROOKLYN, N. Y.
Warranted the Best Pump made for all situations.
KELLY & LUDWIG, AGENTS,
49 and 51 North Seventh Street, Philadelphia

BOOKS —RELATING TO— Steam Engines, Machinery, Heat, Gas, Electricity, Casting and Founding, &c.
DESCRIPTIVE CATALOGUE, 100 PAGES, 1883, SENT FREE ON APPLICATION.
E. & F. N. SPON, 35 Murray St., N. Y.



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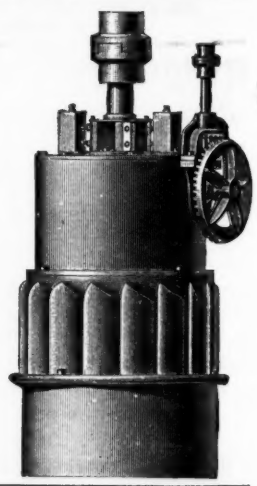
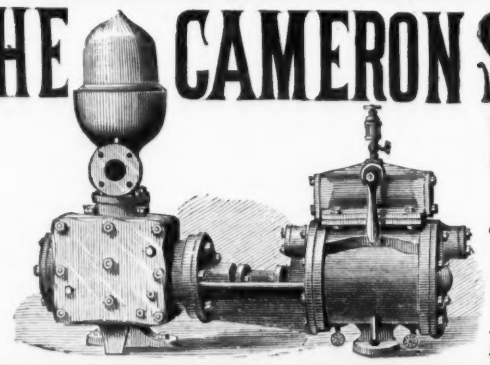
Corn-Mills and Millstones,
ALL SIZES.
THE BEST IN THE WORLD
FOR TABLE MEAL!
Samples of Meal Sent on Application.
NORTH CAROLINA MILLSTONE CO.
Chambersburg, Pa.
(*Please Mention this Paper.*)

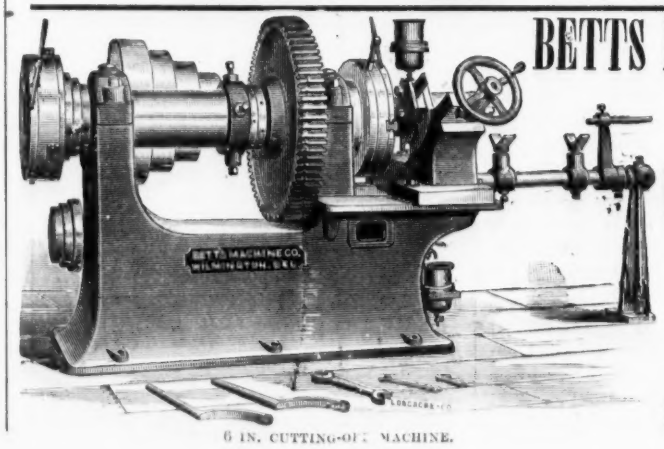
THE HERCULES TURBINE
Gives more power for the same size, also better average results from full to one-half gate than any other water wheel ever made. It is moderate in cost, compact in form, and not liable to get out of order.
—BUILT BY—
THE HOLYOKE MACHINE CO.
SHOPS AT
Holyoke and Worcester, Mass.
Send for Catalogue, Circulars and Price List to either of the above places.



THE CAMERON STEAM PUMP.



Is the Standard of Excellence
AT HOME AND ABROAD.
THE A. S. CAMERON
Steam Pump Works,
Foot of East 23d St., NEW YORK.



6 IN. CUTTING-OFF MACHINE.

BETTS MACHINE CO.
Wilmington, Del.,
MAKERS OF
MACHINE TOOLS
FROM
Improved Patterns.
Three sizes of Cutting-Off Machines: 2½ in., 4 in., and 6 in.

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Our experience in Safety Valves has been a varied one, extending over 15 years, during which time we have tried nearly every valve placed on the market just long enough to become thoroughly disgusted with the working of each and every one of them. We learned all their faults and what to avoid. With this experience in our favor, we have designed quite a number of valves, which we hoped would overcome the difficulties we had met with, but since trying the Consolidated Safety Valve Co.'s NICKEL-SEATED "POP" SAFETY VALVE, we have come to the conclusion that we can make more money selling boilers than we can in designing safety valves.

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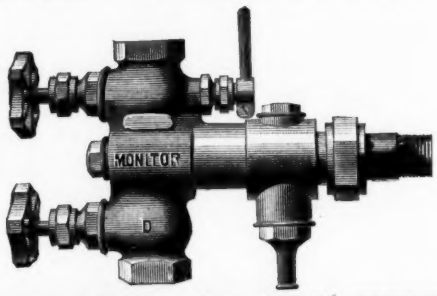

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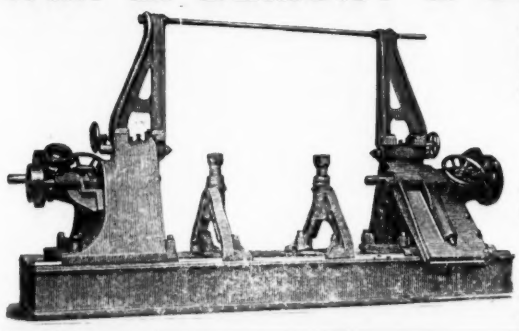

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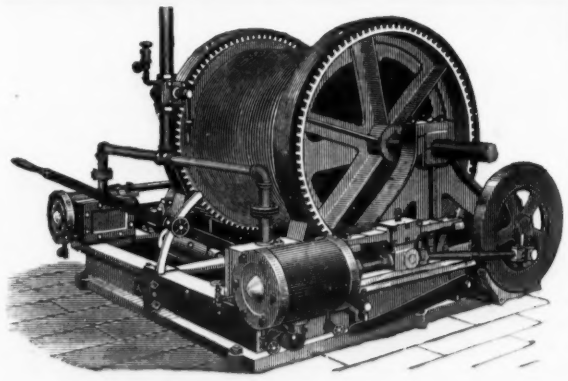

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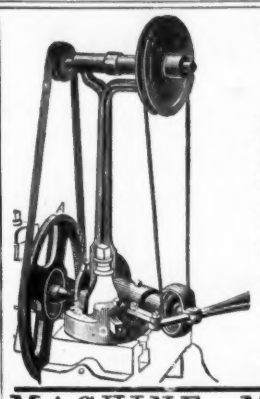

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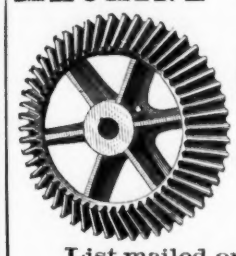

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" 7	1 1-8 "	.95
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" 9	1 3-8 "	1.10
" 10	1 1-2 "	1.10
" 11	1 3-4 "	1.25
" 12	2 "	1.40
" 13	2 1-4 "	1.60
" 14	2 1-2 "	1.60
" 15	3 "	1.80
" 16	3 1-2 "	2.00
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Full set, 19 Dogs,		26.35
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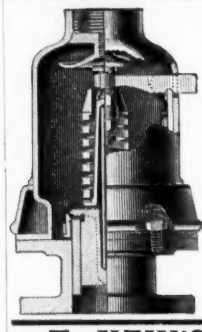

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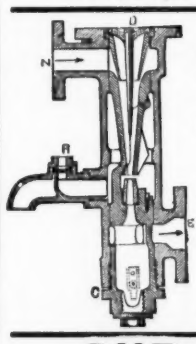

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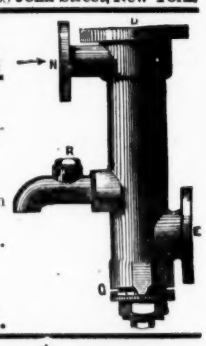

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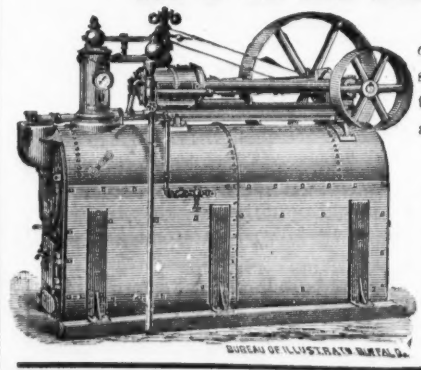

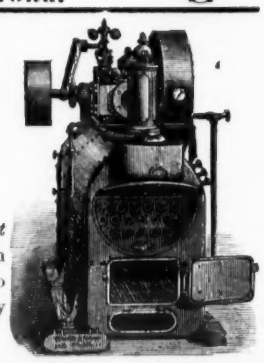

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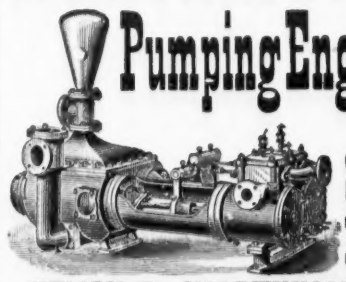

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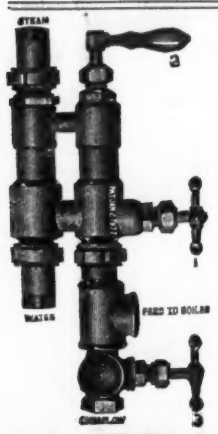

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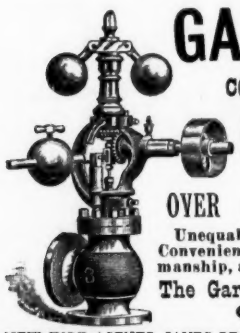

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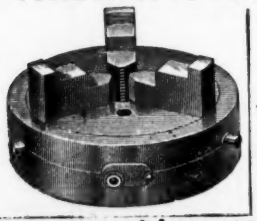

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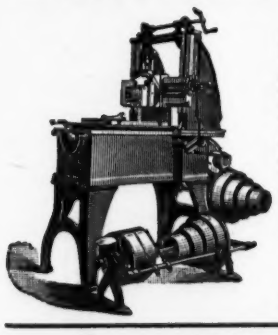

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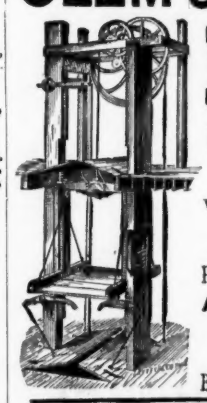

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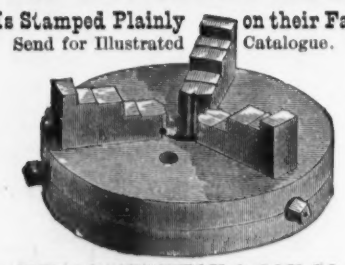

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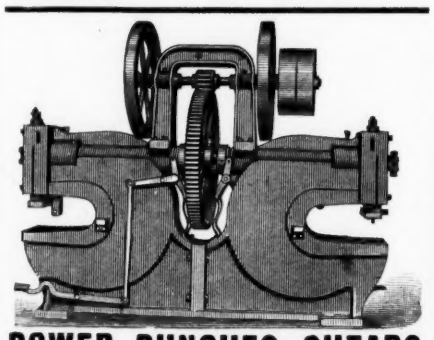

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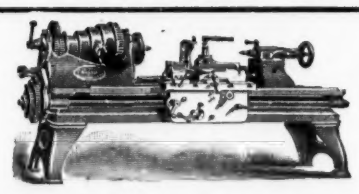

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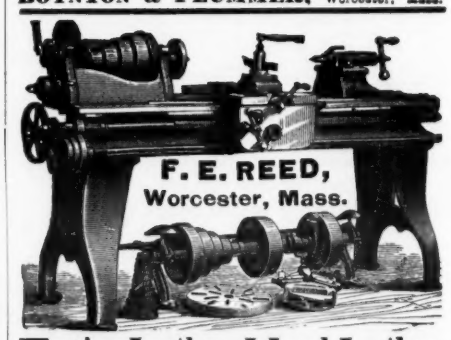

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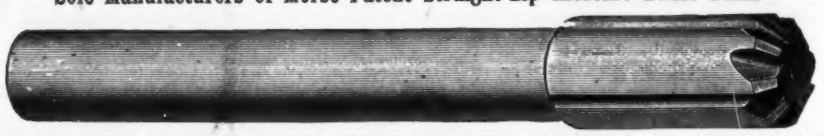

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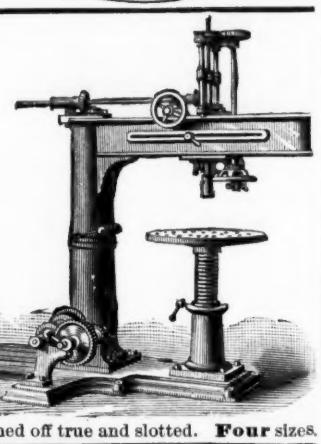

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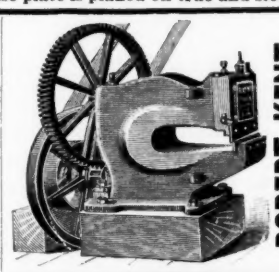

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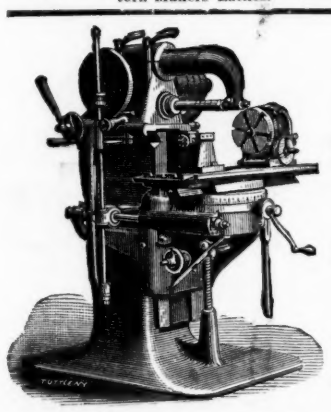

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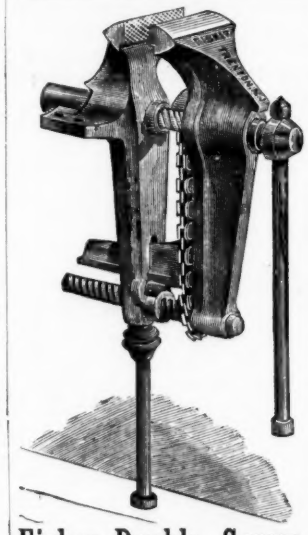

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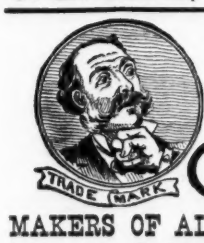

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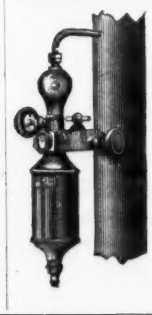

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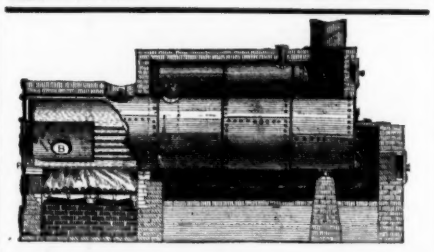

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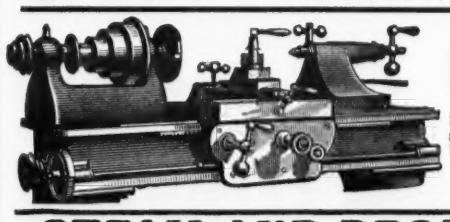

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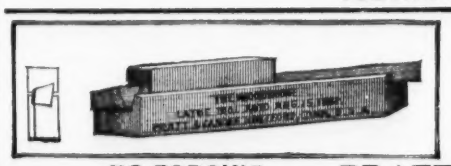

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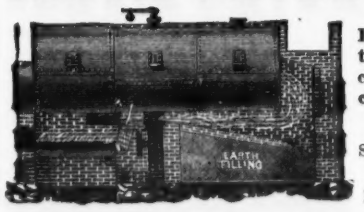

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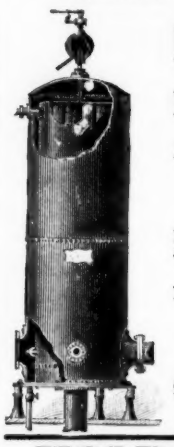

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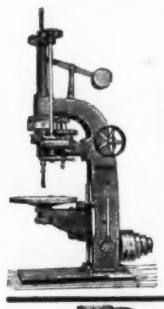

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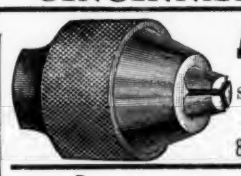

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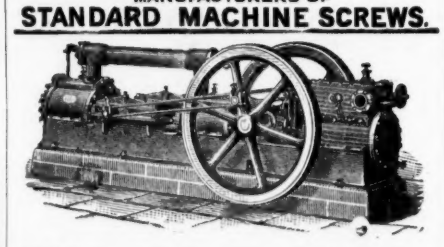

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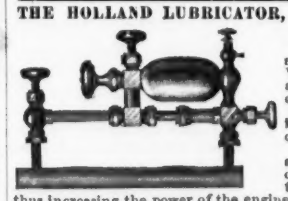

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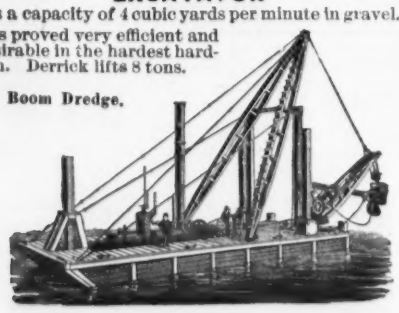

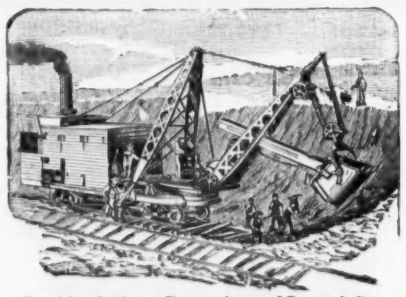

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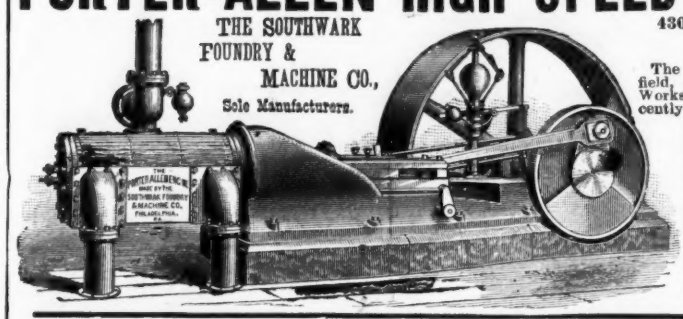

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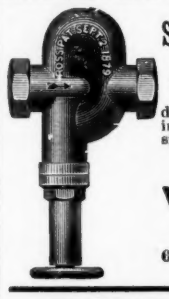

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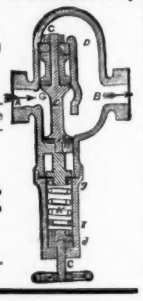

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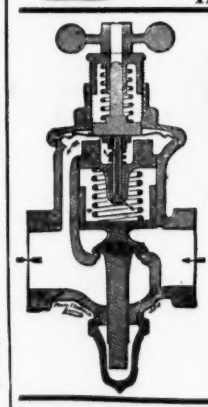

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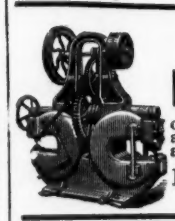

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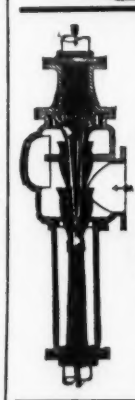

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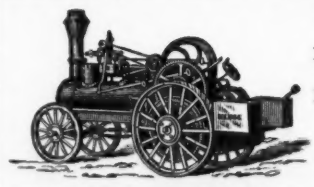

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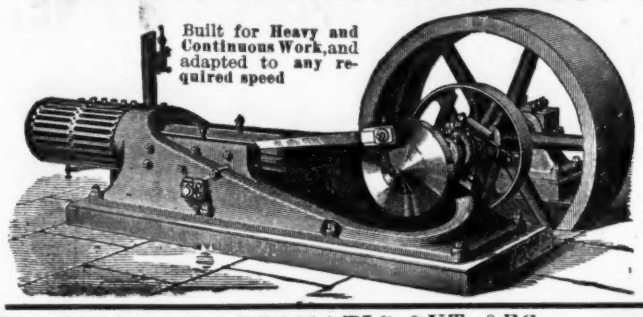

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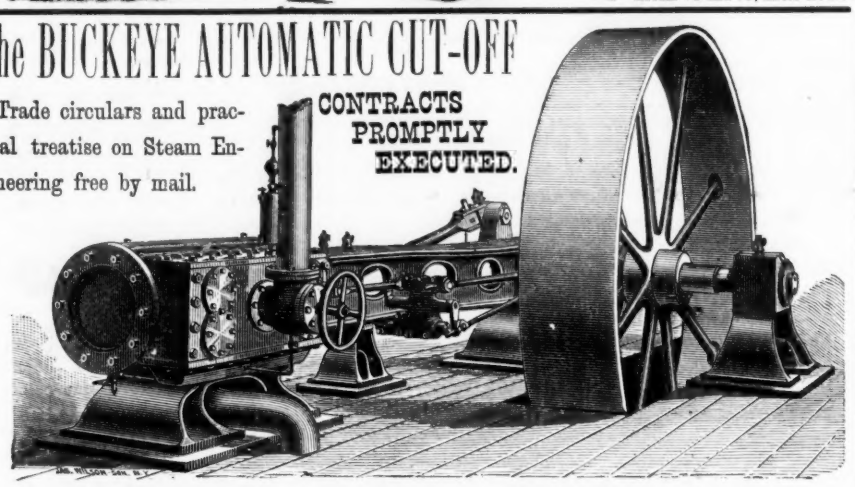

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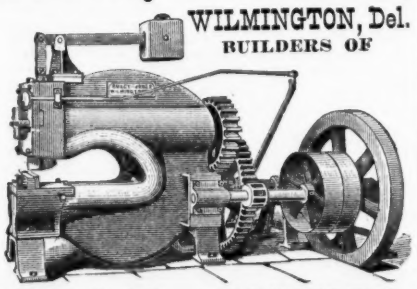

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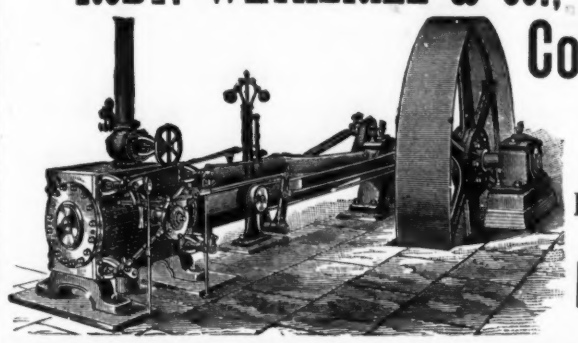

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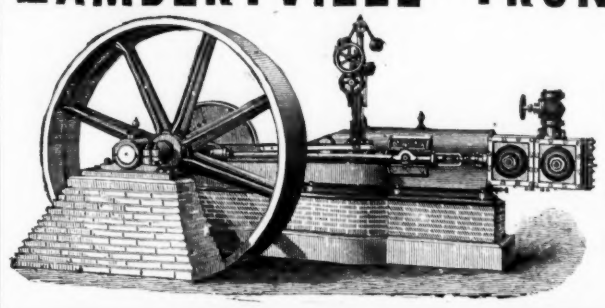

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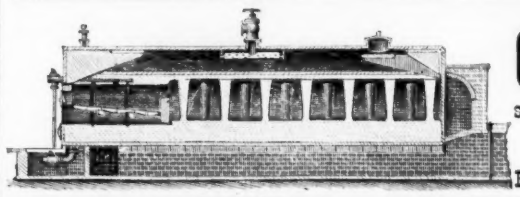

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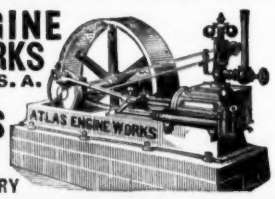

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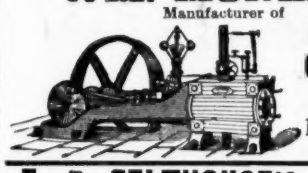

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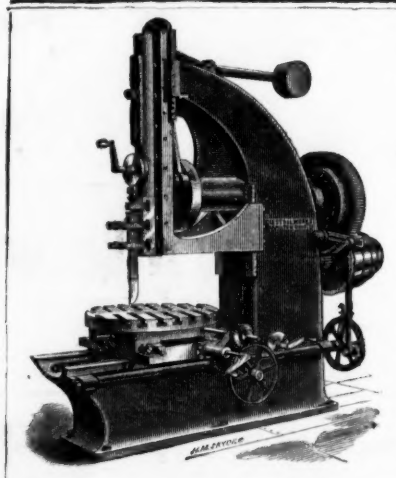

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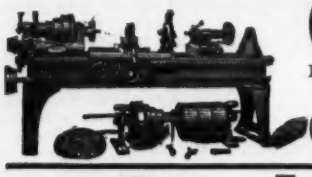

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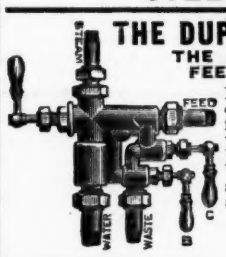

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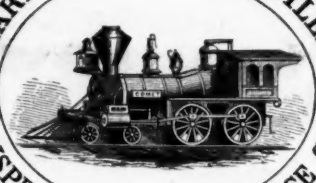

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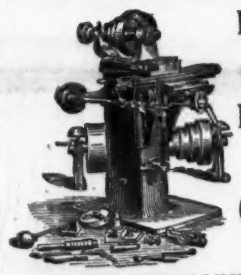

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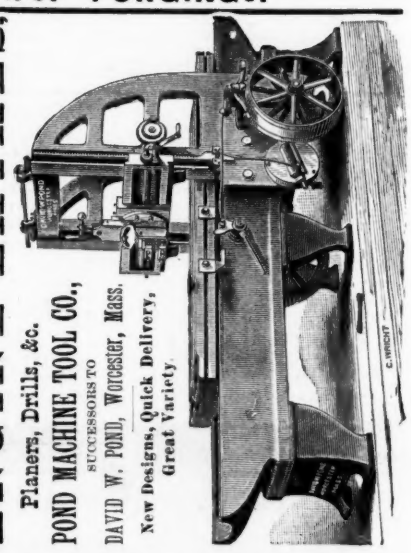

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